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CONSTRUCTION. Aperou general. Construction. General

Construction is a science; it is also an art, i.e., there is necessary for the construction knowledge, experience and a natural faculty. One is born a constructor, the science acquired can only develop the germs deposited in the brains of men destined to give utility and a durable form to the raw material. It is with peoples ar with individuals; some are constructors from their cradles, others never become such; the progress of civilization adds but little to that native faculty. Architecture and construction must be taught or practised simultaneously; construction is the means, architecture is the result; yet there architectural works that cannot be regardel as constructions, and there are certain constructions that cannot be placed in the number of architectural works. Soce animals build, some cells and others nests, halls, galleries, a sort of nests, nets of threads; these are indeed structures, but are not architecture.

To construct for the architect is to employ the materials according to their qualities and their natures, with the preconceived idea of satisfying a need by the simplest and most substantial means, to give to the structure the appearance of durability, suitable proportions subject to certain rules imposed by the senses, reason and human instinct. The methods of construction must then vary according to the nature of the materials, of the means at disposal, the needs to be satisfied, and the civilization within which it is produced.

The Greeks and Romans were constructors; yet these two peoples started from opposed principles, have not employed the same materials, placed them in the work by different means, and satisfied requirements that were not the same. So the appearance of the Greek and that of the Roman monument differed essentially. The Greek employed only the lintel in his structures; the Roman used the arch and consequently the vault; that alone indicates sufficiently how these opposed principles must produce very dissimilar structures, both for the means employed and for their appearance. We do not have to make known here the origins of these two principles and their results; we shall take Roman architecture at the point attained by it in the last time of the empire, for that is the only source from which the middle ages first borrowed.

The principle of Roman construction is this; to establish points of support presenting by their position and perfect cohesion masses sufficiently stable and homogeneous to resist the weight and thrust of vaults; to distribute these loads and t thrusts to fixed piers, whose inert resistance is sufficient. Thus Roman construction is only skilfully calculated solid masses, all whose parts are without elasticity and maintain themselves by the laws of gravity and their perfect adhesion. Among the Greeks stability is obtained only by judicious observation of the laws of gravity; they did not seek for the a adhesion of materials; in a word, they neither knew nor employed mortars. In their monuments the loads only acting vertically, they needed only vertical resistances, vaults being u unknown to them, they did not have to resist inclined pressures, which are termed thrusts. How did the Romans proceed to obtain passive resistances and berfect adhesion of all the i inert parts of their structures and the active parts, i.e., between the points of support of the vaults? They constructed homogeneous masonry of small materials, pebbles or stone chips joined by excellent mortar, enclosing this concrete within facing bricks, rubble or cut stones. As for vaults, they formed these on centerings by means of brick or stone arches and concrete tamped on wooden lagging. This method presented numerous advantages; it was rapid; it permitted the construction of e edifices on the same plan in all countries; employing soldiers or levies to erect them; it was durable and economocal; only required good direction, demanding but a limited number of s skilful and intelligent workmen, under whom could labor a considerable number of mere laborers; it avoided the slow and difficult transportation of materials of great size, and of machines to hoist them; finally it was the result of the social and political state of Roman society. Yet the Romans erected edifices in imitation of the Greeks, like their temples and basilicas; but these monuments are an importation, and must be placed outside true Roman construction.

The barbarians that invaded the Roman provinces did not bring with them arts and methods of building, or at least the elements introduced by them into the midst of expiring Roman civilization could have but a very weak influence. They found the monuments built and used them. Long after the invasion of

the barbarians on Gallo-Roman soil, there still existed a great number of antique edifices; which indicates that the German h hordes did not destroy all. They frequently even attempted to repair, and soon to imitate them.

But after such long disasters, the traditions left by Roman constructors must have been lost in great part; under the Merovingians the edifices erected in Gaul were only barbaric reproductions of antique structures spared by war, or that had been abble to resist long abandonment. The few monuments remaining to us, preceding the Carlovingian period, present to us only structures in which is only perceived a pale reflection of the art of the Romans, rude imitations of the edifices, whose numerous remains still cover the soil. Only under the reign of Charlemagne did men see constructors make some attempts to escape from the ignorance in which the preceding centuries were plunged. The relations uith the East maintained by that prince, his connections with the Lombards, among whom the last traditions of antique art seem to have taken refuge; supplied him with the means of attracting to him and into countries subject to his rule, constructors that he knew how to ut utilize with zeal and remarkable perseverance. His purpose c certainly was the cause of the revival of the Roman arts; but the sources from which he must draw to attain that result were profoundly modified in their principles. Charlemagne could not send architects to study the monuments of old Rome, since he had none; he could only demand artists, geometricians aud skilful workmen from the East, Spain or Lombardy, countries alone possessing them. These brought with them methods already far removed from those of antiquity. The Carlovingian renaissance then produced results very different from what its author probably expected from it. After all the purpose was attained, since the new elements imported into the West soon produced considerable efforts, and from that epoch the arts rapidly p progressed. The history of that advance from the point of view of construction alone, we shall attempt to write, referring our readers to Art. Architecture for all pertainiug to the de development of that art from the 10 th to the 16 th centuries.

Dureng the duration of the Roman empire, either at Rome or at Byzantium, it is easy to recognize that the vaults were t the dominant preoccupation of constructors. From the tunnel

vault they passed quickly to the cross vault, and from the d dome borne on a circular wall or drum, they had reached the the construction of S. Sophia the hemispherical vault resting on pendentives; an immense step, that established a sharp line of separation between the Roman structures of antiquity and those of the middle ages. Neither Rome nor Italy, nor Gaul showed a single Roman edifice in which the hemispherical vault was borne by pendentives. The church of S. Sophia is t the first that furnishes us with an example of that sort of construction, and as everyone knows, it is the largest dome in existence. How did Roman architects established in Byzantium come to conceive and execute a construction of that kind? That is what we shall not seek to unravel. We shall take the fact, where for the first time it appears with an incontestable grandeur of freedom. To cover a circular enclosure by a hemispherical vault was a very natural idea, that was adopted from high antiquity; to cause the penetration of cross vaults into the circular drum was an immediate result of that first step. But to erect a hemispherical dome on a square plan, i.e., on four isolated piers set at the corners of a square, was no l longer a deduction from that primary principle, but an innovation and one of the boldest innovations.

Yet the constructors brought by Charlemagne from Lombardy and the East to the West did not bring with them that mode of construction; as at Aix-la-Chapelle, they were satisfied to erect vaults with octagonal or circular bases on drums rising from the ground. It was only later that derivatives from Byzantine construction had direct influence in the West. As for t the methods of building the Carlovingian structures, they approached Roman methods, i.e., consisted of masses of concrete enclosed in facings of bricks, rubble or cut stone, or again of rubble alternating with courses of bricks, the whole retained by thick mortar joints, as shown in Fig. 1.

We indicate at A the courses of triangular bricks presenting the longer sides at the surface, and at B the courese of rubble scarcely regular and presenting their frequently square faces at the surface. At C is represented a brick with a thickness varying from 1.6 to 2.0 ins, and at D a piece of facing rubble. This was merely a rudely executed Roman structure. But the Romans rarely employed thi method except when they desired

to cover the surfaces with marble slabs or stucco; if they m made the facings of cut stones, they set these with dry joints without mortar and on their quarry beds, and left them large beds, so that the facings should actually become a reinforcement capable of resisting a pressure, that the concrete mass alone could not have borne.

From the first times of the Carlovingian epoch, the constructors also desired to erect structures faced with cut stone in imitation of certain Roman structures; but they did not dispose of the powerful means employed by the Romans; they could neither transport nor indeed raise to a certain height blocks of stone of great volume. Thus they were satisfied with the appearance, i.e., they arranged surfaces formed of facings of stones set on edge and most frequently of small thickness, carefully avoiding holes and filling the spaces felt between these surfaces by small stones sunk in mortar. They sometimes went so far as to desire to imitate Roman bonded construction by setting thick stone facings with dry joints without mortar. It is unnecessary to state how vicious is this construction, the more so because their mortar being mediocre, their lime b badly burned or slaked, their sand dirty and the concrete extremely irregular. Also sometimes they took a middle course, i.e., they constructed the faces of small cut stones joined by thick beds of mortar.

These attempts and experiments did not constitute an art. If in the details of the construction the architects exhibited very moderate skill, if they could only imitate badly the Roman procedures, with greater reason in the entirety of their structures they found themselves constantly attacked by difficulties, that they were not in condition to solve; lacking knowledge and possessing only almost effaced traditions, having neither skilful workmen nor powerful machines, proceeding by groping, they must make,and did make unheard efforts to e erect edifices of small dimensions, to make them stable, especially to vault them. Then in Carlovingian monuments one always recognizes the insufficiency of the constructors, where one cam prove their embarrasment, uncertainty, and often that discouragement produced by lack of power. Aven from that Ignorance of the antique procedures, and especially from the constant efforts of the constructors of the 9 th and 10 th centu-

centuries there came a new art of building; the result of experiences unfortunate at first, but which were repeated with perseverance and a constant improvement, traced a new path not before marked out. No less than three centuries were necessary to instruct these barbarians; still after such slow e efforts, they could flatter themselves with having opened to furtur constructors a new era, that received but little from the arts of antiquity. The imperative necessities by which t these primitive constructors found themselves confronted compelled them to seek resources in their own observations, rather than in the study of the monuments of antiquity, which thew knew but very imperfectly, and that in most provinces of Gaul no longer existed except in the state of ruin. Besides, being ready to adopt foreign products, they subjected them to imperfect procedures, and thus transforming them, made them concur in an art wherein reasoning entered more than tradition. That school was hard; only based uncertainly on the past, finding themselves facing the needs of a civilization in which all was to be created, mossessing only the elements of the e exact sciences, it had no guide other than the expermental; b but that method, if not the most rapid, at least has the advantage of training observing practicians, careful to combine all the improvements that can aid them.

Already in the edifices of the 11 th century construction is seen to make sensible progress, that is only the result of faults avoided with more or less skill; for error and its effects instruct men more than perfect works. No longer disposed of the active means employed by the Romans in their constructions; lacking men, money, transportation, connections, roads, tools and machenes; confined within provinces separated by the feudal rule, constructors could only count on very weak resources, and yet already at that epoch (11 th century), they were required to erect vast monasteries, palaces, churches and ramparts. It was necessary for their industry to supply all that Roman genius could organize, all that our modern civilization furnishes us with profusion. It was necessary to obtain great results at small cost (for then the West was poor), to satisfy numerous and pressing needs on a soil ravaged by barbarians. It was necessary for the constructor to seek materials, occupy himself with the means of transporting them,

combat the ignorance of unskilful workmen, for himself to make observations on qualities of lime, sand and stone, to provide timber; he must not only be the architect, but also quarryman, draftsman, stonecutter, foreman, carpenter, lime-burner, mason, able to aid himself only by his intelligence and his reasoning as an observer. It is easy today for us, when a notary or a merchant builds himself a house without the help of the architect, to regard as rude these first attempts, but the total of the genius then necessary to the constructors to erect a hall or a church was certainly superior to what we demand from an architect of our time, who can build without knowing t the primary elements of his art, as too frequently occurs.
In those times of ignorance and of barbarism, the most intelligent and those elevated above the common workman were alone capable of directing a structure; and the direction of buildings, necessarily limited to a restricted to a restricted number of superior men, must thereby produce original works, in the execution of which reasoning enters for a great part; where calculation is apparent, and whose form is clothed by that distinction that is the particular character of reasoned constructions, subjected to the needs and customs of a people.
Indeed it is necessary to recognize, unless we ourselves must be designated as barbarians, that the beauty of a structure does not consist in the improvements made by a very developed civilization and industry, but in the judicious use of materials and of means placed at the command of the constructor. W With our so numerous materials, the metals supplied by our m mills, the skilful and innumerable workmen of our cities, we erect a vicious structure, absurd, ridiculous, without reason or economy; while with rubble and wood may be built a good, b beautiful and wise structure. So far as we know, never has t the variety nor the perfection of the material employed been the proof of the merit of its employer; excellent materials are detestable if placed in the work away from the place to which their function is adapted, by a man without knowledge and sense. What one should be proud of is the good and proper use of the materials, and not the quantity or quality of these materials. This is stated as a digression, to engage our readers not to scorn constructors, who have at command only badly quarried stone, bad rubble collected from the ground, poorly

burned lime, imperfect tools and weak machines; for with such rude elements those constructors can teach us excellent principles, applicable at all times. And the proof that they can do so is that they formed a school, which from the point of view of practical or theoretical science, the judicious use of materials, has reached a degree of perfection not surpassed i in modern times. It is permissible for those who teach architecture without having practised the art, to judge of the architectural productions of ancient and modern civilizations only by appearance, a superficial form that seduces them; but for us called to construction, it is necessary for us to seek our instruction from the experiments and the progress of those ingenious architects, who start from nothing and have everything to do to solve the problems set by the society of their time. To regard the mediaeval constructors as barbarians, because they must renounce construction by employing the methods of the Romans, is not to wish to take account of the state of the new society, but to disregard the profound modifications introduced into the customs by Christianity, based on the genius of the western peoples; this is to efface several centuries of slow but persistent labor, produced in the midst of society; work that has developed the most active and vivacious elements of modern civilization. No one admires antiquity more than we do, and on one is more disposed to recognize the superiority of the best epochs of the art of the Greeks and Romans over modern arts; but we were born in the 19 th century, and we cannot prevent that between antiquity and us has been much labor; ideas, needs, means foreign to those of antiquity. It is necessary for us to take account well of the new elements, of the tendencies of a new society. We may regret the social organization of antiquity, scrupulously study it, have recourse to it; but do not forget that we neither l live under Pericles nor under Augustus; that we have no slaves; that three fourths of Europe are no longer plunged in ignoraance and barbarism to the great advantage of the other fourth; that society is not divided into two unequal portions, the l larger absolutely subject to the other; that needs have infinitely extended; that the machinery is complicated; that industry continually analyzes all means placed at the disposal of man and transforms them; that traditions and formulas are re-

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burned lime, imperfect tools and weak machines; for with such rude elements those constructors can teach us excellent principles, applicable at all times. And the proof that they can do so is that they formed a school, which from the point of view of practical or theoretical science, the judicious use of materials, has reached a degree of perfection not surpassed i in modern times. It is permissible for those who teach architecture without having practised the art, to judge of the architectural productions of ancient and modern civilizations only by appearance, a superficial form that seduces them; but for us called to construction, it is necessary for us to seek our instruction from the experiments and the progress of those ingenious architects, who start from nothing and have everything to do to solve the problems set by the society of their time. To regard the mediaeval constructors as barbarians, because they must renounce construction by employing the methods of the Romans, is not to wish to take account of the state of the new society, but to disregard the profound modifications introduced into the customs by Christianity, based on the genius of the western peoples; this is to efface several centuries of slow but persistent labor, produced in the midst of society; work that has developed the most active and vivacious elements of modern civilization. No one admires antiquity more than we do, and on one is more disposed to recognize the superiority of the best epochs of the art of the Greeks and Romans over modern arts; but we were born in the 19 th century, and we cannot prevent that between antiquity and us has been much labor; ideas, needs, means foreign to those of antiquity. It is necessary for us to take account well of the new elements, of the tendencies of a new society. We may regret the social organization of antiquity, scrupulously study it, have recourse to it; but do not forget that we neither l live under Pericles nor under Augustus; that we have no slaves; that three fourths of Europe are no longer plunged in ignoraance and barbarism to the great advantage of the other fourth; that society is not divided into two unequal portions, the l larger absolutely subject to the other; that needs have infinitely extended; that the machinery is complicated; that industry continually analyzes all means placed at the disposal of man and transforms them; that traditions and formulas are re-

replaced by reasoning, and that finally for art to endure it must know the atmosphere in which it develops. Now the construction of edifices in the middle ages entered into that new path. We may bemoan this, if we wish; but the fact will no le s exist, and we can only make yesterday the eve of today. It seems to us that what is best is to seek in the work of yesterday what is useful for us today, and to recognize whether that labor has not prepared for the labor of today. That is more reasonable than to disdain it.

It has been frequently claimed that the middle ages were an exceptional epoch, neither connected with what preceded norf followed it, foreign to the genius of our country and to modern civilization. That may perhaps be sustained from the point of view of politics, although such a fact may be very strange in the history of the world, all linked together; but the spirit of party being mixed with it, it is no paradox finding approvers. In architecture and especially in construction, p party spirit has no hold, and we do not see why the principles of civil liberty, why the modern laws under which we have the happines to be born are attacked, when it is demonstrated, that the constructors in the 12 th century knew how to build, that those of the 13 th century were very ingenious and free in the use of the means, that they sought to fulfil the progress imposed on them, by the simplest and least expensive means, that they reasoned correctly and knew the laws of statics and of the equilibrium of forces. A custom may be odious and oppressive; abbots and feudal lords were spendthrifts, if you prefer, exercised an insupportable despotism, and the monasteries and castles inhabited by them might still be constructed with wisdom, economy and great liberty in the use of t the means. A structure is not fanatical, oppressive or tyrannical; these are not applied to a combination of stones, wood or iron. A structure is good or bad, judicious or without reason. If we have nothing to take from the feudal code; that is not saying that we can take nothing from the structures of that time. A court condemns unfortunate Jews or sorcerers to be burned alive; but the hall in which sits that court might be a very good structure, and as well built as that in which our magistrates apply wise laws in an enlightened spirit. A m man of letters, a historian, says in speaking of a feudal cas-

castle; "That resort of brigandage, that residence of petty despots tyrannizing over their vassals, at war with their n neighbors." At once everyone raises a hue and cry about the lord of the castle. How are the edifices accomplices of those who caused their erection, particularly if those structures were erected by just those, who were victims of the abuse of power by their inhabitants? Did not the Greeks in many cases exhibit the most odious fanaticism? Does that prevent us from admiring the Parthenon or the Temple of Theseus?

We believe it time to no longer allow ourselves to be dazzled, we architects, by the discourses of these strangers to the practice of our art, who judge works that they cannot understand, and of which they neither know the construction nor t the true and useful sense, and who are moved by their passions or personal tastes, by restricted studies of a narrow party spirit, cast anathemas on artists, whose efforts, science and practical experience are still of great assistance to us today. It is of slight importance that those feudal lords were tyrants, that the clergy of the middle ages was corrupt, ambitious and fanatical, if the men who built their habitations were ingenious, if they loved their art and practised it with skill and care. It matters little to us that a dungeon shut in the living for years, if the stones of their prison were skilfully cut and present an impassable obstacle; little to us that a grille enclosed a chamber of torture, if the grille were well combined and the iron well forged. Confusion between the institutions and the products of the arts must not exist for us, who seek our own wherever we think of finding it. Let us not be duped at our own cost by restricted doctrines; let us blame the customs of past time, if they seem bad to us; but let us not proscribe the arts, before knowing whether we can derive any advantage from their study. Let us leave to enlightened amateurs the care of discussing the preeminence of G Greek over Roman architecture, and of that over the architecture of the middle ages; leave them to treat these insoluble questions; if we have nothing better to do, let us listen to discussions on our art without knowing how to draw a panel, to cut and set a stone; it is not permitted to profess medicine or even pharmacy without being a physician or an apothecary; but for architecture, that is a different affair!

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To render an account of the first efforts of the constructors of the middle ages, it is first necessary to know the elements at their disposal, and the practical means then in use. The Romans, masters of the world, having established a regular and uniform government in the midst of so many allied or conquered peoples, hand in their handr resources absolutely wanting in the provinces of Gaul divided into little states, innumerable fractions, because of the establishment of the feudal system. When the Romans desired to cover a province with monuments of public utility, could place at a point at a given moment not only an army of soldiers accustomed to labor, but could levy the inhabitants (for the system of forced levies was practised on a vast scale by the Romans), and to obtain prodigious results by the aid of that multitude of laorers. To build rapidly and well, they had adopted methods a according perfectly with that social state. If the constructors of the middle ages had desired to employ those methods, w where would they have found those armies of laborers? How transport into a province without stone, for example, the materials needed for construction, when the ancient Roman roads w were broken, how obtain the money to purchase these materials, beasts of burden, when the provinces were almost at war with each other, when each abbot and each lord considered himself as an absolute sovereign, the more jealous of his power, the smaller the country over which it extended? How organize regular levies of men where several authorities disputed the supremacy, and where laborers were scarcely in sufficient number to cultivate the soil, where war was the normal condition? How to accumulate the enormous mass of provisions required f for the smallest Roman structure? How to feed these laborers at the same point? The religious orders could first undertake important structures, 1, because they gathered at a single po point a sufficient number of laborers combined by a single t thought, subject to discipline, free from military service, owners of areas on which they lived, 2, because they gathered possessions, that rapidly increased under a regular administration, that they formed permanent relations with neighboring establishments, they cleared and rendered healthy uncultivated lands, laid out roads, acquired the richest quarries and the best forests, built shops, offered the peasants protection com-

comparatively secure, and thus rapidly peopled their lands, to the detriment of those of the lay nobles, 3, because by t their privileges and the relative stability of their institutions, they could form within their monasteries schools of artisans, subject to a regular apprenticeship, clothed, fed and supported, working under the common direction, preserving the traditions and recording improvements; 4, because they a alone then extended afar their influence by founding establishments connected to the mother abbey, so that they must profit by all partial efforts made in provinces differing greatly in climate, customs and habits. By the activity of the religious orders the art of construction must rise from barparism in the 11 th century. The order of Cluny as the most important (Art. Architecture Monastique), most powerful and most enlightened, was the first to have a school of constructors, whose new principles must produce in the 12 th century monuments freed from the last Roman traditions. What are those principles? How were they developed? That is what we are to examine.

PRINCIPLES. For new principles to develop in anything, it is necessary for a new condition and new needs to appear. When the order of S. Benedict was reformed in the 11 th century, t the tendencies of the reformers say nothing less than to change the entire society, that was scarcely founded and already was falling into decay. Those reformers as skilful men commenced by abandoning the mouldy traditions of antique society; they started with nothing and no longer desired habitations both luxurious and barbarous, which until then had served as refuge for monks corrupted in the preceding centuries. They built themselves huts of wood, lived in the midst of fields, taking life as men could when left to their industry alone in a desert. These first steps had a persistent influence, when even the increasing wealth of the monasteries, their importance in the midst of society soon brought them to exchange their cabins for durable habitations built with luxury. To rigorously satisfy needs is always the primary law observed, not only in the entirety of the structures, but in the d details of construction; never to sacrifice stability to a v vain appearance of wealth is the second. Yet stone and wood are always stone and wood, and if one can use these materials in quantity more or less great in a structure, their function

is the same among all peoples and in all times. However rich and powerful the monks, they could not hope to build as the Romans had done. Thus they endeavored to erect structures both substantial and durable (for they indeed counted on building for the future) with economy. To employ the most ordinary Roman method, i.e., to compose their structures of massive concrete faced with surfaces of bricks or rubble, was to set at work more laborers than they had at command. To construct with enormous blocks of stone, carefully dressed and set, would h have required impossible transportation for lack of solid roads, and a considerable number of skilful workmen, beasts of burden, expensive machines established with difficulty. Thus they took a middle course. They erected principal points of support by employing cut stone for the surfaces as a facing, filling the interior with concrete; For the connecting walls they adopted masonry of small stones rough dressed on the surfaces or square stone slabs, likewise enclosing concrete of p pebbles and mortar.

Our Fig. 2 gives an idea od this kind of construction. To tie together the different parts of the structure and tie the walls lengthwise, long timbers were buried in the masonry at different heights, beneath the window sills and over the cornices, as we have shown at A. (Art. Chainage). In these structures, stone is economized as much as possible; no block is hollowed and all are set on edge; this is only a facing though executed with the greatest care, not only are the surfaces d dressed, but also the beds and joints, and these stones are set dry without mortar like Roman masonry.

This kind of construction is apparent in the great monastic structures of Cluny, Vezelay, Charite-sur-Loire (11 th and 12 th centuries). The materials employed by the monks are those procured in the vicinity, in quarries which they owned. And it must be recognized, that they were used in accordance with their qualities and defects. If the materials present d defects, if the stone splits easily and no other could be procured except at considerable expense, they took care to place it under the least disadvantageous conditions, and to protect these materials from the effects of dampness and of frost, t they sought to relieve them from atmospheric action by raising them from the soil externally by courses of stone purchased

in the most distant quarries.

In the works of men counting only on their own resources a and their own strength, there is always a certain amount of intelligence and of energy of great value in the eyes of those knowing how to observe, however imperfect and rude are these works otherwise, which one does not find in the works produced by very civilized men, but to which industry supplies numerous elements, and that have to make no effort to satisfy all their needs. These primitive seekers then frequently become masters, and their efforts a precious instruction, for it evident-requires more intelligence to make something when all resources are lacking, than when they are within the reach of the most mediocre minds.

Roman structures, because of the absolute stability of their points of support and the perfect cohesion of all upper parts (the result obtained by means of immense resources, as we have stated), present immovable and passive masses, as if they were monuments cut in a solid block of tufa. Romanesque constructors not being able to dispose of such powerful means, soon recognized that their structures did not offer a concrete entirety, tied together and a perfectly stable combination; that the piers being composed of facings of stone enclosing a concrete of frequently poor mortar, and that the walls were not bonded in their entire height, suffered the effects of unequal settlements, that caused cracks in the structure, and consequently serious accidents. It was then necessary to seek m means suited to neutralize these effects. Romanesque constructors from the 11 th century desired by motives then developed (Art. Architecture) to vault most of their great edifices; t they had inherited Roman vaults, but they were not able to m maintain them by the powerful means, that the Romans had been able to adopt. It was then again necessary, that their intelligence should replace that lack of power. The Roman vault c could only maintain itself on condition of having absolutely stable points of support, for that vault, whethe tunnel, cross or heimspherical, forms a homogeneous covering without elasticity, that breaks into pieces if any cracks occur in its intrados. Desiring to build vaults in imitation of the Romans, and not being able to give them absolutely stable points of support, it was necessary for the Romanesque constr-

constructors to find some method for maintaining them in acco-dance with the instability of the points of support destined to bear and to abut them. This task was not easily solved; so experiments, attempts and trials were numerous; but still from the origin of these attempts is seen the birth of the new system of construction, and this system is based on the principle of elasticity, replacing the principle of absolute stability adopted by the Romans. With rare exceptions the Roman vaults are made of concrete; if reinforced by brick arches, these a arches are embedded in the thickness of the concrete itself. and unite with it. The Romanesque constructors, instead of building the vaslt of concrete, constructed it of rough rubble embedded in mortar, but set as voussoirs, or as dressed r rubble composing masonry of small stones; already these vaults, if a vertical movement occurred in the points of support, presented a certain elasticity, because of the combination of t the voussoirs, not breaking like a homogeneous covering, and following the movement of the piers. But this first modification did not entirely reassure the Romanesque constructors; they established under these vaults at certain dastances at the most resistant points of support, transverse arches of cut stone turned beneath the intrados of the vaults. Those transverse arches, a sort of permanent elastic centres, like every arch composed of a certain number of voussoirs, followed the movement of the piers, yielded to their settlement and their divergence, thus maintaining like a wooden centering t the shells of masonry built above them.

Romanesque constructors had taken from the Romans the cross vault on a square plan produced by the intersection of two ha half cylinders of equal diameters. But when they wished to e erect vaults on piers placed at the angles of rectangles, the cross vault could not be applied; in that case they adopted the tunnel or continuous half cylindrical vault without intersections, and at the piers they strengthened these tunnel vaults by transverse arches of cut stone, on which they relied to avoid the bad effects of a longitudinal rupture in these tunnel vaults, because of the movement of the piers. Again, a and we insist on the point, this was a permanent centering. Still the obstacles and the difficulties seemed to appear as the constructors believed they had found the solution of the

problem. The effects of the thrusts of vaults so perfectly k known to the Romans were almost ignored by the Romanesque constructors. The first among them who had the idea of turning a round tunnel vault on two parallel walls certainly believed, that he had forever avoided the inconveniences attached to t visible carpentry, and combined a construction both solid and durable, with a monumental appearance. His illusion must have been of short duration, for after removing the centres and la lagging, the walls were overturned outwards, the vault falling between them. It was then necessary to find means suitable for preventing such disasters. They first strengthened the w walls by external buttresses, by piers projecting inside, then at these buttresses and piers they turned transverse arches under the tunnel vaults. Burying longitudinal timbers in the thickness of the wall between the piers at the springing of t the tunnel vaults, they believed thus to arrest their thrust between these piers. This was always only a palliative; if so some edifices thus vaulted resisted the thrust of the tunnel vaults, a great number fell some time after their construction.

But it is necessary for our readers to have an accurate idea of this last kind of construction. We give (3) its entirety and details. At A are the internal piers supporting the transverse arches E, at B being the longitudinal timbers retaining the tunnel vault at its springing. In order to carry the thrust of the transverse arches as low as possible, the constructors gave a strong projection to the capitals G. If vaults so conceived were turned on piers sufficiently solidly built with well tied or very heavy materials, if the walls were thick a and solid from bottom to top, if the buttresses had a sufficient projection, and the transverse arches and consequently the piers were not too widely spaced, these tunnel vaults, reinforced by lower arches, could be maintained. But if as o occurred in naves bordered by side aisles, the walls rested on the archivolts of isolated piers, if these isolated piers, that were always tied to make them as thin as possible,to not obstruct passage and obstruct the view, did not present a sufficient bearing to receive the external buttresses projecting above the vaults of the side aisles, then the upper tunnel vault in spite of, or with its transverse arches gradually pushed the piers and walls outward, and the entire structure fell.

Already about the end of the 11 th century, many of the churches so vaulted and built for a half century fell in ruin, and it was necessary to rebuild them. These accidents were an instruction to builders; this gave them the opportunity for observing certain phenomena of statics, of which they had not t the least idea; it caused them to recognize that the wooden timbers embedded in the mansonry and deprived of air quickly became rotten, and that the vacancy they left only hastened the destruction of the edifices; that the walls having commenced to overturn, the thrust of the vaults directly increased their moment; that finally if the tunnel vawlts were placed over naves with side aisles, the disorder occasioned by t the high vaults were such, that it was impossible to maintain the piers and walls in a vertical plane.

Yet the moment had not then come, when the constructors u undertook to accurately solve the problem of the stability of vaults placed on parallel walls; they must still make attempts to avoid the effects of the thrust on the vertical walls. Romanesque constructors knew that cross vaults presented this advantage of exerting pressures and thrusts only on the four points of support receiving their springings. Recognizing that tunnel vaults exerted a continuous thrust on the tops of the walls, they sought to replace and suppress them, even in naves composed of bays oblong in plan, by cross vaults, so as to transfer their entire weight and thrust to the piers, which they hoped to make stable. But as we have stated above, the Roman cross vault could be built only on the square plan; it was then necessary to find a new construction of cross vaults suited for oblong vaults. Geometrically, these vaults could not be drawn, and it was only by experiment that men succeeded in constructing them.

Already during the 11 th century, the constructors had composed vaults that are allied to both the dome and the cross vault, in that these vaults, instead of being generated by t two half cylinders intersecting at right angles, are formed by four round arches connecting the four piers and two diagonal arches, which are themselves round, consequently having g greater radii than these of the four first. When one knows t the means employed to construct the cross vault, it is easily understood what had been the motive of that modification of

the Roman cross vault. To build the vault are necessary wooden centres on which are laid planks. Now to make a Romam cross vault, there must be made four semicircular centres and two diagonal centres, whose curve is given by the intersection of the half cylinders; the curve of these diagonal centres is n not a semicircle, but an ellipse obtained by ordinates, as indicated in Fig. 4. Let A B be the diameters of the cylinders and B C the horizontal line of the plan over which they intersect. the two cylinders A B, A C. Working on a quarter, and dividing the revolved semicircle into a certain number of equal parts D E, E F, F G, G B, perpendiculars are dropped from these dividing points D,E,F,G on the diameter A B, prolonging them to intersect the diagonal B C. Thus one obtains on that diagonal the dividing points d, e, f, g; from these points e erecting perpendiculars to the diagonal B C, and taking on t these perpendiculars lengths d d' = D'A, e e' = E'E, etc., t there are fixed the points d', e', f', g', through which is traced the curve of intersection of the two half cylinders. This curve having a rise d d' = radius D'D, and a diameter B C greater than the diameter A B, cannot be a semicircle. Although very simple, this geometrical drawing appeared too complex to the Romanesque constructors. Having then traced a semicircle on the diameter A B for making the wooden centres for the four generating arches of the vault, they traced a s second semicircle on the diameter B C for makink the two diagonal centres. Thus the crowns d'of the intersection of these two diagonal centres found themselves at a level higher than the crowns D of the generating arches, and the vault instead of being the result of the intersection of two half cylinders, was composed of nameless surfaces, but approaching the dome. This elementary demonstration is necessary, for it is the key of the entire system of vaults of the middle ages. This first result, of ignorance rather than calculation, however was one of the most fruitful principles in the history of construction. Further it indicates something other than gross ignorance, if denotes a certain reflective liberty in the use of the means of building, whose importance is considerable; and indeed once freed from Roman traditions, the constructors in the middle ages were more and more consistent with their principles; they soon comprehended their entire extent, and frankly aban-

abandoned themselves to them; however, let us follow them step by step. Once the principle of the Roman cross vault was thus modified, it was necessary to apply these vaults to rectangular plans, for the constructors recognized the danger of wide tunnel vaults.

Then (5) let A B C D be the rectangle of a bay of the nave in plan, that must be covered by a cross vault. Let A E B be the semicircular intrados of the transverse arches revolved, and A F C be the semicircular intrados of the side arches also revolved. It is clear that the radius H F will be shorter than the radius G E, also the crown E is higher than the crown F. If we trace a semicircle on the diagonal A D as being the curve on which must intersect the vaults generated by the semicircles A E B, A F C, it will result that the angles A I, B I, D I and C I will be concave instead of convex for their entire length, on the contrary for about two thirds of their length, and principally in approaching the crown I.

Indeed, let (6) be the cross section of the vault on H O. Let H(F' be the section of the side arch, H'I'O the vertical projection of the diagona A D or B C. The straight line drawn from the crown F to the crown I' leaves a segment of the circle K L I' above that line; from which it results that this portion of the vault must be convex to the intrados instead of being concave, and that consequently it could not be constructed. Then placing the side and transverse arches on the diagonal arches and laying the planks to close the triangles of the masonry vaults, the constructors covered this centering by a thick mass of earth following the curve F'I'F", i.e., given by the summits of the diagonal and side arches; then t the diagonal groins again became convex, on this mass were set courses of rubble parallel to the section F'I' to close the vault.

The result of these exferiments was that the cross vaults were no longer intersections of cylinders or cones, but of ellipsoids. The first difficulty being overcome, rapid improvements could not fail to develop. But at first, how and by what mechanical procedures were these vaults constructed? T The Roman cross vault was constructed by bays and had no transverse arches; it rested on piers or projecting columns, as represented in Fig. 7, i.e. (see the horizontal projection A

of one of those vaults), the diagonals B C, D E, produced by the intersection of two half cylinders of equal diameters and forming convex groins, rested on the projecting angles of the piers. But the Romanesque architects having first strengthened the great tunnel vaults by transverse arches, as shown by our Fig. 3, and replacing those semicylindrical vaults by oblong cross vaults, retained the transverse arches; they could not do otherwise, since the diagonals of these vaults were s semicircles, and their curves rose above the crowns of the arches, whose diameters were given by the distance between t the piers.

To make ourselves understood, let (8) be the longitudinal section of a Roman cross vault composed of bays; the line A B is horizontal; it is the section of a longitudinal cylinder. Let (8 bis) be the longitudinal section of a Romanesque cross vault on an oblong plan, the line A B is a series of curves, or at least of broken lines joining the points C D, summits of the transverse arches at the points of intersection of the diagonal semicircles. It was necessary to retain beneath the points C D projecting arches, transverse arches, which were merely permanent centres, as we have already stated. Henceforth the diagonal groins must start from a point beyond the p projection of the piers or columns, these being only destined to support the transverse arches, i.e., (9), that the groins must start from points F instead of from points G, and that the springings of the transverse arches rest on the bearings F, H, G, I. When it was then necessary to close the vaults, t the constructors placed the lagging supporting the masses or form of earth on the extradoses of these transverse arches, a and on the two diagonal arches of carpentry.

In the structures erected by all the building peoples, logical deductions succeed with fatal rigor. A step cade in advance can never be the last; one must always progress; from the moment that a principle is the result of reasoning, one soon becomes its slave. Such is the spirit of the western peoples; it appears when the society of the middle ages commences tc feel and to organize itself; it cannot stop, for the first that establishes a principle by reasoning cannot say to reason; "thou shalt go no farther." Constructors in the shadow of the cloisters recognized this principle from the 11 th cen-

century; A century later, they were no longer the masters. B Bishops, monks, nobles, citizens, had they desired it, could not have prevented Romanesque architecture from producing the architecture called Gothic; the latter was the fated consequence of the former. Those desiring to see in Gothic architecture (entirely lay) anything but the emancipation of the people of artists and artisans taught to reason, who reasoned b better than their masters, and in spite of themselves carried them very far from the aim, that all at first desired to attain, with the forces placed in their hands; those believing Gothic architecture to be an exception, an oddity of the human mind, certainly have not studied the principle, which is only the rigorously followed application of the system introduced by Romanesque construction. It will be easy to demonstrate this. Let us proceed.

We already see at the end of the 11 th century the principle of the Roman cross vault set aside.[1] Transverse arches are d definitely accepted as a living, elastic and free force, a s skeleton on which rests the vault proper. If the constructors admitted that these permanent centres were useful transversely, they must similarly admit their utility longitudinally. No longer regarding the vaults as a homogeneous concrete covering, but as a series of compartments with curved and free surfaces resting on flexible arches' the rigidity of the lateral walls contrasted with the new system; it was necessahy for the compartments to be free in every sense, or otherwise breaks and cracks would be the more dangerous, because these vaults were supported on flexible arches in one direction and on rigid walls in the other. They turned side arches on the walls lengthwise between the piers. These side arches were merely half transverse arches partly embedded in the wall, but not dependant on its construction. By this means the vaults rested only on the piers, and the walls became mere enclosures, t that if necessary cloud be built afterwards or omitted. A bearing was required for these side arches, a special point of support; Romanesque constructors then added for this purpose a new member to their piers, and the cross vault began in the reentrant angle formed by the impost of the transverse arch and the side arch, as indicated in Fig. 10. A is the transverse arch, B the side arch, C the groin of the vault' the plan

of the pier is at D. But if the pier was isolated, if the nave was accompanied by side aisles, it assumed in plan Fig. 10 bis. A is the transverse arch of the great vault, B the archivolts supporting the wall. Above these archivolts, this wall recedes at F so as to permit the pilasters G to bear the upper side a arches. C is the transverse arch of the side aisle; D are the groins of this side aisle, and H those of the high vaults. T The vaults to the side aisles are turned on the transverse a arches C, the extradoses of the archivolts B and on a side a arch partly embedded in the wall of the side aisle, and supporting like the upper side arches of Fig. 10. Thus already the members of the vaults give the horizontal section of the piers, their form being derived from these members. Yet these vaults were abutted insufficiently, and movements made themselves felt in the piers; hence the principal ribs of the vaults, the transverse arches were deformed. Not knowing how to resist the thrusts, constructors first occupied themselves with rendering this effect less injurious. They had observed the greater the area of the section of an arch between the intrados and extrados, the more the movements produced in the arch occasioned disorder. They were not the first to recognize this law. The Romans before them, when they had to turn great arches, took care to form them of several rows of concentric voussoirs, independent of each other, as indicated by Fig. 11 at A. Arches constructed in this manner formed as many hoops acting separately, and retainiug a much greater elasticity, consequently with more resistance than an arch of the same section constructed according to the method indicated at B.

Note 1.p.21. In the nave of the church of Vezelay must be established the abandonment of the Roman system. There the cross vaults on oblong plans are already intersections of ellipsoids with projecting transverse and side arches.

Romanesque constructors according to thes crinciple composed their transverse arches of two series of concentric voussoirs; that of the intrados assuming a section or portion of the radius longer than that of the extrados, and as the tarnsverse a arches were only permanent centres intended to receive the en ends of the lagging on which the vault was built; they gave to a second series of voussoirs a projection beyond the first and suited to support the ends of the lagging. Fig. 12 expla-

explains this method. At A is the row of voussoirs of the intrados, at B that of the voussoirs of the extrados with the two projections C intended to receive the ends of the lagging D on which the vaults are built. The side arches having a smaller diameter and being only subject to the effects of the thrusts, they are composed of a single row of voussoirs, as shown in Fig. 12 bis, with the projection necessary for placing the lagging. It is already evident that the Romanesque constructors left in evidence their material means of construction; that far from seeking to disguise them, composed their architecture with these means themselves. Are other proofs of this fact desired? The Romans terminated the tops of their columns by capitals; but the projection of the abacus of these capitals bore nothing; it was merely an ornament. Thus when the Romans placed the cross vault on the columns, as frequently occurred, for example in halls of baths, the impost of the vault was vertically over the side of the column (13). And then a singular thing, whose reason cannot be given, not only the sh shaft of the Roman column bore its capital, but the complete entablature of the order; so that indeed the entire portion between A and B served nothing, and that the strong projections B could have been utilized only for placing the carpentry centering intended for closing the vaults. It must be confessed that this was much luxury for an accessory purpose. When the Romanesque constructors placed an arch on an isolated or engaged column, the capital is only a corbelling destined to receive the impost of the arch, a projection serving as transition between the cylindrical shaft of the column and the s square bed of the impost.(14). Then a capital is only an ornament, but is a useful member of the construction. (Art. Chapiteau).

Had the Romanesque constructors a crowning cornice to be pl placed on the top of an external wall, being economical of t time and caterials, they carefully avoided cutting at great cost the different members of that cornice in a single stone; for example, they placed projecting corbels in the last course of rubble, and on these corbels they placed a stone slab serving as gutter for the roofing.(Art. Corniche). It is useless to insist more on these details, that will be presented in th their places in the course of this work.

The construction of the vaults was then the great preoccupation of the architects of the middle ages; as we have just shown, they had reached combinations ingenious in themselves, but had not yet found means suitable to maintain with certainty these vaults, and were reduced to expedients. Thus for example, they constructed the compartments of these vaults in tufa or light materials, so as to diminish the effects of the thrusts, they reduced their thickness as much as possible; t they piled masonry beneath the roofs of the side aisles at t these thrusts, in the hope of preventing the overthrow of the piers; they placed transverse ties of wood at the buttresses, concealed by the slope of the roofs, to render the piers of the external walls stable. These expedients were sufficient in small structures; in large ones they only lessened the effects of the thrusts without entirely destroying them.

In is unnecessary to take account of these effects to conceive the series of reasonings aud of attempts by which constructors passed from ignorance to knowledge. Let (15) be the t transverse section of a Romanesque church of the end of the 11 th century like that of Vezelay, built with cross vaults over the side aisles and the central nave. At A is represented the construction as conceived by the architect; at B such as the stress in the high vaults had deformed it. Care was t taken to leave iron tie rods at C D at the springings of the transverse arches; but these tie rods were probably forged ba badly and broke. A century and a half after the construction of the nave, the effects produced had already caused the fall of several vaults, and in haste had beeu constructed the external flying buttresses E dotted in our drawing. These effects were; 1, pushing outward the piers and the walls connecting them between F and G, consequently a sinking of the transverse arches at the crown H, crushiug of the beds of these arches at I at the intrados; 2, the dislocation of the transverse a arches of the side aisles, as our Fig. indicates; and consequently pushing outward the external walls of the side aisles. These effects were produced everywhere in the same manner. In studying them, the constructurs believed and not without reason, since the fact was constant, that all the evil was produced by the thrust of the round arches and the vaults they pa partly supported; that the too flat concavity of these vaults

had an oblique action, too great a thrust, that the thrust of a round arch increased directly by its action; that the deformation suffered by these arches indicated their weak points, viz; the crown and haunches, that always when a round arch is not perfectly abutted, and the piers supporting it spread apart, these arches are deformed, as indicated by Fig. 16.

Let a vault have a diameter of the transverse arches of 23 ft., the depth of the voussoirs of these arches being 2.4 ft.; the walls then moving outward at the springings, of these arches about 0.66 ft. each, then the diameter of the semicircle with centre at B becomes 24.3 ft., and the points a of the s springings of the transverse arch moved out at a′. The arc a b, a little less than a quadrant, becomes a′b′; for assuming that the pier breaks and pivots at a point 9.8 ft. below the springing a, and the centre B will rise to b′. The consequences of this first movement will be; 1, the lowering of the c crown D to d and the sinking of the arc b c to b′c′. This effect will continue until the moment when the diagonal curve b e, traced from the intrados to the extrados of the arc b c, will be shorter than the distance between b′and e′. It must be noted in passing, that Romanesque vaults, assumed to have been constructed elliptical, only acquired that curve because of the spreading of the piers. A spreading of 1.3 ft. between these piers from the verticals gives 1.3 ft. of sinking at the crown of the arch; the difference in that case between the h half diameter of the arch and the rise of the curve is then 2.6 ft. Constructors must have observed these effects and have sought means to prevent them. The first means that they appear to have employed is this; having a nave whose transverse arches are 23. ft. diameter at the intrados and voussoirs 2.0 ft. deep, and having noted (Fig. 16), that the arc b′c′in sinking pressed the lower arc a′b′ at the intrados at b′, and the crown at the extrados at e′, they concluded that the curvilinear triangle b′a′c) was useless, and that the diagonal b′e′alone offered resistance; then starting from this principle, they traced (17) the two semicircles of the intrados and extrados A B C, D E F; then they sought the centre O of a circular arc connecting the point A of the intrados with the point E of the extrados of the round arch placing a joint at E G and not a keystone, to avoid the effect of equilibrium visible in Fig.

16, they jointed the voussoirs of this new arch according to the normals of the curve A E, i.e., radiating from the centre O. If cracks were again produced in these transverse arches, thus composed of two diagonal curves A E, the constructors p proceeded with the arch A E as with the round arch, i.e., they moved the cenhre O to O′ on the diameter, so as to obtain an arch connecting the point A wit the point G.

Thus in the vaults of the 12 th century, we see the transverse arches gradually diverge from the round arch to approach the equilateral arch. The best proof that we can give in support of our hypothesis is the exact measurement of a great number of these broken primitive arches, which give accurately a rise greater than the half diameter by once, twice or thrice the depth at the impost. But this proof is only evident to t those who have accurately measured a great number of transverse arches of that epoch. Here is a general observation, that can be made by everyone, without recourse to measurements made with difficulty.

There are provinces, for example like Ile-de-France, where Romanesque round transverse arches have but small depth of v voussoirs. Now these in the first vaults having broken arches, the pointing of these arches is scarcely sensible, while in provinces where the Romanesque round arches have a strong depth as in Burgundy, the pointing of the transverse arches of the first vaults abandons the round arch, and is much more marked.

The adoption of the broken (pointed) arch was thus the result of the observations the constructors had made of the deformation of round arches,viz.; the rising of the haunches and the sinking of the crown, which exist in a great number of t transverse arches of the 12 th century traced as indicated in Fig. 18, i.e., with four centres; two centres A for the partial arcs B C, D E, and two centres G for the partial arcs C D. comprising the haunches; this to present from C to D a greater resistance to the effect of rising felt between the points C and D; for the more nearly the line C D approaches a straight line, the less subject is it to break from within outwards; by this trace the constructors avoided giving transverse arches a sharpness, that could not fail to skoch those accustomed to the round arch.

From the moment that the transverse arch composed of two c circular arcs came to replace the round arch, there resulted from that innovation a multitude of consequences, which must carry the constructors far beyond the aim, that they claimed to attain. The broken or pointed arch (since this is its true name) employed as a means of construction, required by the o observation of the effects resulting from the thrust of round arches, is an actual revolution in the history of the art of building. It has been stated; "the constructors of the middle ages invented nothing in adopting the pointed arch, there are pointed arches in the oldest monuments in Greece and Etruria. The section of the treasury of Atreus at Mycenae gives a pointed arch, etc." That is true; yet is always omitted a very important point; this is that the stones composing these arches are corbelled; that their beds are not normal to the curve b but are horizontal; that is less than nothing for those occupying themselves only with the external form; but for us practicians, this detail has its importance. Besides when the Greeks or the Romans would build vaults generated by pointed a arches, how could that be done if the general principle of construction was not derived from the combination of these curves and the observation of their oblique effects? It is v evident that from the day when man invented the compasses and the means of tracing circles, he discovered the pointed arch; what matters it to us if he did not establish a complete system on the observation of the properties of these arches? Men have also desired to see in the use of the pointed arch for the construction of vaults a symbolical or mystical idea; they have pretended to demonstrate, that these arches had a sense more religious than that of the round arch. But men were entirely as religious at the beginning of the 1■ th century as at its end, if not more so, and the pointed arch appeared just at the moment when the spirit of analysis, or the study of the exact sciences and of philosophy commenced to germinate in th the midsl of a society until then almost theocratic. The pointed arch and its consequences carried into construction appeared in our monuments, when the art of architecture was practised by laymen, and left the enclosure of the cloister, where until then it had been exclusively cultivated.

The last Romanesque constructors, those that after so many

experiments had come to reject the round arch were not dreamers; they did not reason upon the mystical sense of a curve; they knew not whether the pointed arch was more religious than the round arch; they built, which is more difficult than to think with an empty head. These constructors have to support wide and high vaults on isolated piers; they tremble at the removal of the centering of each bay, they daily apply a palliative to the apparent evil; they observe with anxiety the least movement, the least effect produced, and that observation is an incessant and fruitful instruction; they have only vague and incomplete traditions, obscurity is around them, t the monuments they build are their only models; on them they make experiments; they have recourse only to themselves, respecting only their own observations.

When one thoroughly studies the structures built at the beginning of the 12 th century, succeeds in classifying them c chronologically, and follows the progress of the principal sc schools that built in France, Burgundy, Normandy and Champagne, one is still seized today by that sort of fever that possessed the constructors, sympathises with their anxiety, their haste to reach a safe result; applauds their perseverance, the truth of their reasoning, the edvelopment of their knowledge, so l limited at first, soon so profound. Certainly such a study is useful for us, constructors in the 20 th century, who are disposed to take appearance for reality, and who frequently place vulgarity in the place of good sense.

Already at the beginning of the 12 th century, the pointed arch was adopted for the great tunnel vaults in a part of Burgundy, Ile-de-France and Champagne, i.e., in the provinces most advanced and most active, if not richest. The high naves of the churches of Beaune, Saulieu, Charite-sur-Loire, the c cathedral of Autun, are covered by tunnel vaults formed of t two intersecting circular arcs, although in these same monuments the archivolts of doorways and windows remain round arches. It is a necessity of construction that imposes the pointed a arch in these edifices, and not a particular taste; for a remarkable fact, all architectural details of these monuments reproduce certain antique forms borrowed from the Gallo-Roman edifices of the province. Thanks to that innovation of the p pointed arch applied to tunnel vaults, these churches have r

remained standing until our days, not without having suffered disorders sufficiently serious to require two centuries later the use of new means suitable to prevent their ruin.

But the edifices in which one finds the transition from the system of Romanesque construction to that called gothic is the porch of Vezelay. This porch is by itself alone a monument composed of nave with three bays and side aisles with vaulted galleries above. The plan of this porch, built about 1150,[1] is entirely Romanesque and does not differ from that of the nave, erected fifty years earlier; but its section presents notable differences from that of the nave. Already about the end of the 11 th century, the constructors of the nave of the church of Vezelay had made a great advance by replacing the high vaults by cross vaults, previously being tunnel vaults; but these vaults on oblong plans generated by round transverse and side arches, show experiments, uncertainties and the inexperience of the constructors. (Art. Architecture Religieuse, Fig. 21). In the porch all arches are pointed, vaults are cross v vaults without projecting groins, and are constructed of rough rubble plastered; the high vaults are very skilfully abutted by those of the galleries of the first story. This entirety p presents a perfect stability.

Note 1.p.31. It must be stated here, that Burgundian architecture was at least 25 years behind that of Ile-de-France; but the monuments of the transition are lacking in Ile-de-France. The church of S. Denis was built about 1140, already n nearly Gothic in system of construction, and the edifices intermediate between that and those frankly Romanesque no longer exist, or were entirely modified in the 13 th century.

We give (19) the transverse section of the porch of Vezelay; the vaults of the galleries are generated by the side arches A of the great vaults, which are actual archivolts, and by t the side arches B with much longer springings; hence the inclination A B of the crowns of the lateral vaults, that form a continuous abutment securing the great vaults. The bays being oblong and the side arches springing from the same level as t the transverse arches C, the crown A of these side arches is at a level below the crowns of these transverse arches' the great vaults by reason of that arrangement are very much raised, and their projecting groins are scarcely apparent. At D'

we have represented the detail of the imposts of the arches at the level D of the pier, and at G is the plan with the lines of the arches and the groins of the vaults. This construction of vaults nowise resembles Roman construction; already the independence between the different parts of the structure is admitted and developed.

Yet the vaults of the porch of Vezelay, excepting two, are without groins or projecting groin ribs, they hold only by a adhesion of the mortar and each forms an homogeneous and concrete cavity, like the Roman vaults. The sole two vaults of this porch possessing groin ribs could do without them; these are merely a decoration and only supported actually by the r rubble compartments. But this was an experiment, that soon h had important consequences. Constructors had already obtained by means of transverse and side arches, independent and resistant for each vault, a sort of elastic skeleton on which, if settlements occurred, these vaults could move indepeudently of each other. They wished to go farther, they desired the c concave triangles of these vaults to be independent of each other, and for this they composed the vaults of two very distinct elements, the arches and the compartments; the arches are regarded as permanent centresof the compartments , as neutral concavities destined to close the triangles left between the arches. They commenced by avoiding a primary difficulty, which until then had always troubled the architects; they returned to the vault on a square plan, comprising two oblong bays, if necessity required; i.e., they traced their vaults in horizontal projection as indicated in Fig. 20.

Let A B C D be a square, exact or nearly so matters little, comprising two bays of the nave, A E B F, E C F D, the diagonals A D and A C generate the vault; these two diagonals are the diameters of two exact semicircles, revolved into the plan; these two semicircles having the same diameters will necessarily intersect at the point G, the master crown. Taking a distance = radius G A and laying it off on the perpendicular G I, the pointed arch E I F is so traced that the point I falls on the point G; this is the transverse arch whose horizontal projection is E F. Taking a distance less than the radius G A, but greater than half the width A B of the nave, and laying it off on the perpendicular H K, the pointed arch A K B is t traced; this is the transverse arch, whose horizontal projec-

projection is A B or C D. Finally, taking a distance I M less than the line H K and greater than half the line B F, the pointed arch B M F es drawn; this is the side arch, whose horizontal projection is B F, F D, etc. Cutting these centerings in wood according to the four curves revolved on the same line O P (20 bis), stone arches with extradosses are turned on these centerings, obtaining the skeleton of the vault represented by Fig. 21.

These are the primitive vaults termed vaults with groin ribs. One will note that these vaults are generated by a semicircle, which at first supplies the diagonals; the semicircle determines the heights of the pointed arches. Then it may be said in passing that the groin arches (such are termed the diagonal arches) are round; which indicates that the word groin is not suitable for the pointed arch. But this is not the time to discuss words (Art. Ogive), and our remark is only made here to indicate one error among so many others, on which basis one frequently judges an art that he knows badly. The pointed arch had been adopted by the last Romanesque architects, as we have seen above, to diminish the effects of thrusts. Its part is now extended, and it becomes a practical means for closing vaults, whose actual generatrix is the round arch.

When (22) a cross vault is generated by two cylinders intersecting at a right angle, the arches A B, C D; A C, B D, are round and the intersections A D, B C are depressed arches, since the crown E does not exceed the level of the crown F, and the diameters A D, B C are longer than the diameters of the semicircles A B, C D. That is not dangerous, if the vault A B C D is homogeneous and solid, if it forms a shell in a single piece like the Roman vaults. But if the constructor desires to preserve a certain elasticity in the triangles of his vaults, if he wishes the diagonal groins A D, B C to be ribs, and if he desires the triangles A B E, C D E, A C E, B D E, to rest on these ribs as on permanent centerings, and this vault has a great span, then one conceives that it would be imprudent to trace the diagonal arches A D, B C, that fulfil such an important function, in a curve less than a semicircle. If such a trace be not absolutely contrary to good construction, at least it presents difficulties in execution, either to find the points through which these depressed curves

must pass, or in the cutting of the voussoirs. The round arch avoids these and is incomparably more stable. The first constructors of frankly Gothic vaults do something apparently very simple; instead of tracing a round arch with the diameter A B like the Roman constructors, they traced it with the diameter A D. This is actually their sole innovation, and we believe that they did not suspect the consequences o a fact apparently so natural. But in the essentially logical art of the constructor, based on reasoning, the least deviation from accepted principles rapidly brings the rigorous consequences, that take us very far from the point o starting. It must be stated that the first Gothic constructors were justly repelled by the experiments of Romanesque constructuor, that mostly ended in deceptions, but were not frightened by the results of their new methods, yet on the contrary with rare sagacity sought to profit by all the resources that they offered.

The Gothic constructors did not invent the pointed arch; it existed, as we have already seen, in structures whose system was frankly Romanesque. But the Gothic architects applied the pointed arch ao a system of construction of which they were indeed the sole and actual inventors. There were pointed arches in the 12 th century in all western Europe. There was no Gothic construction at that epoch, except in a small portion of the actual area of France, however this may displease those, who do not admit, that anything was invented among us before the 16 th century.

It is with the pointed arch as with all inventions in this world, that are in a latent state quite before receiving their true application. Gunpowder was invented in the 13 th century; it was actually employed only in the 15 th, because the moment had come when this agent of destruction found its application necessary. It is the same with printing; stamps were made from all time; but the idea of combining letters of wood or of metal and of printing books only came when many persons could read, when a knowledge and instruction was distributed among all classes, and were no longer the privilege of some clerics shut up in their monastery. Leonard de Vinci, and perhaps others before him, foresaw that steam would become a motive force easily employed; yet steam engines were only made in our times, because the moment was come, when that agent by

its power was alone capable of sufficing for the needs of our industry and our activity. It is then puerile for us to say, that the pointed arch being in all times, the constructors in the 12 th century merely claimed its invention. Certainly, t they did not invent it, but they employed it in accordance w with its qualities, and the resources it presented in construction; and we repeat that only in France, i.e., in the royal domain and some adjacent provinces, did they know how to apply it to the art of building, not as a form chosen by caprice, but as a means of causing to prevail the principle, whose serious and useful consequences we are to seek to make known.

If in adopting the round arch for the diagonals of vaults, constructors at the end of the 12 th century had desired to apply it to transverse and side arches, they would first have had to make a step backward, since their predecessors had adopted the pointed arch after sad experiences, as having less t thrust than the round arch; they they would have found themselves much embarrassed in closing their vaults. Indeed the c crowns of the transverse and side arches traced as semicircles would have been found above the level of the crowns of the g groin arches, so that it would have been difficult to fill t the compartments with rubble, and that if closed, the appearance of these vaults would have been very disagreeable and t their thrust considerable, since they would have been composed at first of round transverse arches with the enormous load, that the rubble compartments would have added. On the contrary, the advantage of the pointed arch adopted for the transverse arches in cross vaults is, that only to thrust very little by itself, but also to suppress a great part of the load of the rubble compartments, or rather to render this load nearly vertical. Indeed, let (23) be the plan of a cross vault, if the arches A D, C B be round and the transverse arches A B, C D are also round, revolution of these arches will give for the groin arches a semicircle E F G, and for the transverse arch the semicircle E H I. In that case filling the triangle C O D with rubble will load the circular arch K H L, i.e., a about three fifths of a semicircle. But if these transverse arches are traced like the pointed arch E M I, filling the t triangle C O D with rubble will only load the portion of that arch comprised between P M R, the points P and R being given

by the tangent S T parallel to the tangent V X, and the portions of the compartment between E R and I P will alt vertically. If the transverse arches be semicircles, the oblique load on each triangle of rubble will be O N, Q; Q', N'; while if t traced pointed as indicated in our Fig., that load will be o only O N Y, Y', N'.

The experimental method suffices to give these results, and at the end of the 12 th century, constructors had no other. It is for us to demonstrate the accuracy of this method.

We have just stated, that the point K at which commences t the load of the compartment gives an arc I K, which is about one fifth of the semicircle. Now (24) let A B be a quadrant, O C a line drawn at 45°degrees dividing this quadrant into two equal parts, the voussoirs from C to B, if not supported by the pressure of the other voussoirs from B to D, would overturn by the laws of gravity, and consequently would thrust against the voussoirs between A and C. Then is C where the rupture of the arch occurs; but account must be taken of the friction of the surfaces of the voussoirs and of the adhesion of the mortar. That friction and adhesion suffice still to m maintain in its plane the voussoir F and to make it stable on the lower voussoir G. But the voussoir F participating in the weight of the voussoirs between F and B affects the voussoir G and sometimes one or two below the point at which the beds of the voussoirs give an angle of 35° degrees, which is a little less than one fifth of the semicircle. Only above that p point can rupture occur, when it must (Fig. 16), and consequently that the active load commences.

Whether the calculation be theoretical or practical, it is certain that the constructors of the 12 th century counted for a moment to sufficiently reduce the thrusts of vaults to omit the abutments, and to maintain them on piers of moderate thickness, provided that they were loaded; for at first they did not think it necessary to oppose flying buttresses to thrusts, that they believed they had neutrailzed, either by the obliquity of the groin arches, or by the pointed curve of the transverse arches. Yet experience soon demonstrated to them, that they were mistaken. The resultant of the oblique thrusts of these round groin arches, added to the thrust of the pointed transverse arches, was strong enough to overturn piers very

high above the ground, and that were merely struts without b bearing. Then they placed flying buttresses, and at first only at the junctions A of the three arches (25), omitting them at the poin s B receiving the isolated transverse arches. But what level should be reached ty the head of the flying buttress? There was a difficulty, greater because theoretical calculation does not give exactly that point, and that only long experience can indicate. As far as one can judge of this by the small number of primitive flying buttresses preserved, h here is the method pursued by the architects.

Let (26) A B C be the transverse arch separating the great vaults; also let from the centre D of the arc A B be drawn a line D E at an angle of 35° degrees with the horizon; let F G be a tangent at the point H; let A I be the thickness of the wall or pier; the tangent F G will cut the external line I K of the pier at the point L. That point gives the intrados od the voussoir at the head of the flying buttress. That arch is then a quadrant or a little less, its centre being placed on the line K I prolonged or a little inside that line. The load M N of the flying buttress originally is quite arbitrary, small at the top M, greater over the haunch at N, which gives a small inclination to the upper line N M. Soon effects appeared in that construction because of the thrusts of the vaults and in spite of these flying buttresses; this is the reason; behind the haunches of the arch and vaults at T were built m masses of bastard masonry, as much to load the piers as to m maintain the haunches of the arches and the compartments. These masses indeed had the advantage of preventing rupture of the arches at the point H; but the entire load of the compartment acting from K to O, and that load being considerable, t there resulted a small rise at the crown B, the arch being l loaded from O to B, and consequently a deformation indicated in Fig. 26 bis. This deformation produced a rupture at the p point O′, a level above the mass, consequently a very oblique thrust O′P above the head of the flying buttress. Here the l laws of equilibrium were broken. Hence it was necessary to r rebuild all the flying buttresses of the primitive Gothic monuments some years after their construction; and then men were satisfied by raisiug the head of the flying buttress, or this was doubled by a second arch.(Art. Arc-Boutant).

It is seen that we do not conceal the false movements of t these constructors; but like all entering a new path, they could only reach their aim after many trials. It is easy today, when we have monuments built with care and knowledge, like the cathedral of Amiens or that of Rheims, to criticize the a attempts of the architects of the end of the 12 th century; but at that epoch when only existed Romanesque monuments of small size and very badly constructed, when the exact sciences were scarcely foreseen, the new task imposed on themselves by the architects bristled with difficulties recurring continually, that one could succeed only by a series of observations made with the greatest care. These observations formed t the skilful constructors of the 13 th and 14 th centuries. It must be said in praise of the architects, that having adopted the new principles of construction, without precedents, they pursued the developments with a tenacity and a rare perseverance, withou looking backward, in spite of the difficulties, that arose at each opportunity. Their tenacity is the more h honorable in that they could not foresee, in adopting the principle of construction of Gothic vaults, the consequences n naturally arising from that system. They acted as do men moved by a strong conviction, they opened for their successors a b broad and sure way, in which western Europe could march without obstacles for three centuries. Every human conception is stained by some error, and the truly immovable in everything is yet to find; each discovery bears in its bosom in seeing the light the cause of its ruin; and man has no sooner adopted a principle, than he recognizes its imperfection and defect; his efforts tend to oppose the defects inherent in that principle.

Now of all conceptions of the human mind, the construction of edifices is one of those finding itself in presence of the m most serious difficulties, because they are opposed natures, some material, the others moral. Indeed not only must the constructor seek to give the materials employed the most suitable form, according to their special nature; he must assemble them so as to resist the different forces, external agents; but again he is compelled to submit to the resources at his command, to satisfy the moral needs, to conform to the tastes and the customs of those for whom he builds. These are the d

difficulties in conception, the efforts of intelligence of the artist; there ahe again the means of execution from which the constructor cannot free himself. During the entire Romanesque period the architects had made vain attempts to harmonize two principles that seemed irreconcilable, viz:- slenderness of vertical points of support, economy of materials, and the use of the Roman vault more or less changed. Some provinces had adopted pure Byzantine construction, because of influences f foreign to the western spirit.

At Periguesx was built after the end of the 10 th century the church of S. Front; from this isolated example started t the school. But it must be recognized that this sort of building was foreign to the new spirit of the western peoples, and the constructors of S. Front of Perigueux erected that church, as might modelers reproducing forms with texture unknown to them. Thus for example, the pendentives supporting the domes of S. Front are constructed by means of courses set corbelled with beds not normal to the curve, but horizontal; if these pendentives do not fall in, this is because they are maintained by the mortar and adhere to the masses before which extends their concave surface. In similar structures, one sees no more than an attempt made to reproduce forms, whose geometrical reason is not understood by the constructors. Besides complete ignorance, pitiable expedients, applied well or badly at the moment when the difficulty presents itself; but no foresight.

There are a great number of Romanesque structures, that i indicate a complete lack of foresight on the part of architects. Some monument is begun with the vague idea of terminating it in a certain manner, which remains half finished, the constructor not knowing how to solve the problem he has set himself; another can be completed only by the use of means ev evidently foreign to its primary conception. It is seen that the primitive Romanesque constructors built day by day relying on inspiration, by chance and according to circumstances, perhaps even counting on a miracle to perfect their work. The legends attached to the cons ruction of great edifices (were t the monuments not there to show us the embarrasment of the architects) are full of dreams in which these architects saw s some angel or saint, taking the trouble to show them how they

should build their vaults, or maintain their piers, which does not always prevem those monuments from falling soon after t their completion, for faith does not suffice for building.

Perhaps without being less credulous, the architects of the end of the 12 th century, mostly if not all laymen, thought it prudent in the matter of construction to not expect the intervention of an angel or saint in erecting an edifice. Thus (a curious fact meriting mention) the chronicles of monasteries, legends and histories, so lavish of praise for the monuments built during the Romanesque period, that enlarge so complacently on the beauty of their construction, their grandeur and decoration, although many of these monuments are only bad structures of rubble badly conceived and worse executed, are abruptly silent at the end of the 12 th century, when architecture passed from the cloisters into the hands of laymen. By chance is a word of the edifice, a dry and laconic ph phrase; nothing of the master's work.

For example, is it credible, that in the voluminous register of Notre Dame of Paris, that comprises documents dating in the 12 th century, not a single word is said of the construction of the existing cathedral? Laborious and intelligent architects came from the people, who were first able to free them from effete traditions; who had frankly entered into practical science; who formed that army of skilful workmen soon scattered over the entire surface of the western continent; w who opened the way to progress, to bold innovations; finally, who belonged in so many ways to modern civilization; who first possesses its spirit of research, its need of knowledge; if their attempts allowed their names to be forgotten; if scorning efforts by which they profited, those pretending to direct the arts of our time endeavour to traduce your works, at least among so many past ind present injustices, our voice rises to reclaim the place belonging to you, and that your modesty lost to you. If less preoccupied by your labors, you had made your science valued like your colleagues of Italy, had boasted of your own genius, we should not be compelled today to search in your works to bring to light the profound experience acquired by you, your practical means so judiciously determined, and particularly to defend you against those incapable of comprehending, that genius may develop in the shadow; that it is of its essence itself to seek the silence of obscurity; against

so great a number, who judge by faith in decisions rendered by passion or interest, and not after their own examination.

Yet it must be stated; it is no longer permitted today to decide questions in historytorythose concerning the arts, politics or literature, bu simple affirmations or denials. And retrograde minds are those desiring to judge these questions by relying on old methods or on their prejudices. There is no sensible artist, who dares to assert that we should construct our edifices and our houses as done in the 12 th or 13 th centuries; but each just mind can understand, that the experience acquired by the masters of that time could be useful to us, so much the more as there masters innovated. The most difficult obstacle for us to overcome, the real and living obstruction, it must be confessed, is indolence of the mind; everyone wishes to know without taking the trouble to learn, and pretends to judge without knowing the documents in the case; the truest principles, best written and most useful, will be placed among old ideas out of use, because a witty man has derided them; and the listening multitude is too happy to applaud a criticism, which avoids the trouble of learning. A sad glory after all, which consists in prolonging the duration of obscurity; it cannot profit him, who acquires it in an age that boasts of casting light on everything, whose activity is so great, that not being able to find in the present sufficient food f for its intellectual needs, it even desires to unroll the past before itself.

If in the eyes of persons who have studied it with care and have brought into that study an enlightened criticism, our F Frence architecture of the Renaissance is superior to the Italian architecture of the 15 th and 16 th centuries, does not that come from the fact, that our Gothic schools, in spite of the abuses of the later time,,long formed skilful workmen and intelligent constructors, knowing how to subject the form to reason; so these schools were particularly suitable to free the spirit of architects and workmen, to familiarize them with the numerous difficulties surrounding the constructor? We know that this language cannot be understood by those, who judge the different forms of our art according to their feelings and their prejudices; hence we do not address those persons but architects, those long acquainted with the resources for the

difficulties presented by the practice of our art. Certainly for artists the study of an art where all is foreseen and calculated, which even sins by excess of investigation and of practical means, in which matter is both master of form and subject to principle, cannot fail to develop the mind and to prepare it for the innovations required by our time.

It would be to leave our subject to explain how at the end of the 12 th century was formed a powerful school of constructors; how that school was protected by the episcopate, which desired to reduce the importance of the religious orders, possessing the sympathy of the people from which it sprung, and reflecting their spirit of progress and research, accepted by the secular nobility that did not find in the monks all elements needed in building its habitations; how that school may be said to profit by favorable circumstances and strongly established itself, and by that acquired a great independence. It will suffice for us to indicate that state of things, new in the history of the arts, to cause the consequences to be appreciated.

We have already seen where constructors had arrived about 1160, how they had been led ts modify successively the Romanesque vault, which was only a degenerate tradition of the Roman vault, and to invent the so-called cross vault. This great advance having been made, there remained much still to be done. The first result of that innovation was to compel constructors to design their edifices by commencing with the vaults, and consequently to leave no more anything to chance, as too frequently occurred to their predecessors; that method appears strange, but consists in drawing the ground plans from the projected construction of the vaults and is eminently rational. What end is it proposed to attain? to establish vaults on points of support. What is the principal object? The vault. The points of support are only the means. Roman constructors had already been led to derive the plans of their vaulted edifices from the form and extent of those vaults themselves; but that principle was only general, and from the examination of a Roman plan of the late empire, one cannot always conclude that such a part had a tunnel vault, a croos vault or a portion of a sphere, as each of these vaults could be placed indifferently on these plans in many cases.

It was not so in the 12 th century; the horizontal plan not only indicates the number and the form of the vaults, but even their different members, transverse, side and diagonal arches; and these members in turn determine the arrangement of vertical points of support, their relative height and diameter. From which one must conclude, that to trace definitely the g ground plan and proceed to the execution, it was necessary first of all to make a diagram of the vaults, of their heights and springings, to know accurately the dimensions and forms of the voussoirs of the different arches. The first Gothic c constructors so quickly became familiar with this method of taking all construction by its top in order to successively trace its bases, that they adopted it even in edifices not vaulted, but with floors or carpentry, they no longer found it bad, as we shall see later.

The primary condition for establishing the plan of an edifice at the end of the 12 th century being to know if it must be vaulted, it is then necessary when the number and direction of the arches of these vaults are known, to obtain the trace of the springings on the capitals, for the trace of the s springings will give the form and dimensions of the abacuses of the capitals, the number, strength and location of the vertical supports.

Then assuming the hall (27) having to be vaulted, 39.4 ft. in the clear and composed of bays 19.7 ft. between axes. Adopting the system of cross vaults crossed by a transverse arch according to the method of constructors at the end of the 12 th century. It is necessary to trace the lower bed of the springings of the arches starting at A'B, and to know the width of the voussoirs. We admit that these voussoirs for a hall of that extent must have 1.3 ft. in width and height; we recognize that at that epoch the different arches of the vault are turned with voussoirs similar in diameter and form. We also recognize that the side arches spring considerably higher than the transverse and groin arches, the little columns serving to support them frequently exceeding the level of the diagonal and transverse arches; that in tracing the bed of the impost of the transverse and diagonal arches, we must take i into account the passage of the little column supporting the side arch, as we take account of the side arch itself. Let

(28) be the detail of the horizontal trace of the springing of the arch at B; at this point spring only a transverse and two side arches. These determine, for it is necessary for the transverse arch to separate from the side arches at its impost. Let A B be the face of the wall; the side arch usually has a projection of half the width of the diagonal arch or of the transverse arch, when these two arches have similar sections, or half the diagonal arch when that and the transverse arch have different sections. In the present case, the side arch has a projection of 0.7 ft. from the face of the wall. At C we draw a line parallel to A B. The axis of the transverse arch being D E, points F and G being taken each at 0.7 ft. from that axis, we draw the two parallels F I, G K, which give the width of the transverse arch. Laying off 1.4 ft. from F to I′, we have its depth between the extrados and intrados; we can then trace the proper section in the square F I′K′G; this is the lower bed of the impost. Either the column bearing the side arch rises above the level of this bed as indicated at L, or as sometimes [1] happens, the side arch springs from the capital supporting the transverse arch; then laying from the axis D E 1.4 ft. on the line A B gives us the point M, a and we inscribe the section of the side arch in the rectangle E O N M. It is understood that this side arch enters the wall a few inches. The lower bed of the impost being thus found, i it is necessary to trace the abacus of the capital, whose profile must form a projection around the imposts of the arches. If the side arch rests on a column rising to its impost as m marked at L, the abacus P R S is returned square to die against the little column L of the side arch. If on the contrary, the section of the side arch descends to the capital of the transverse arch, the abacus takes the form P T V X on the horizontal plan. To trace the column beneath the capital in the first case, from the apex R to the right angle of the abacus we draw a line at 45° degrees; this line cuts the axis D E at the point O, which is the centre of the column, and which is given a diameter, such that the projection of the abacus from the shaft of the column must be much greater than the radius of the column. Then there remains between the column and the face of the wall a space, that is filled by a pilaster masked by the column and the little column of the side arch. To trace

the column beneath the capital in the second case, we take t the centre Y on the axis D E, so that the projection of the abacus from the face of the column may be much greater than its half diameter; then the capital forms a corbel or bracket, and is more concaved under the side arch than beneath the face of the transverse arch.

Note 1.p.46. Church of Nesle.

Now take in Fig. 27 the impost A of the two side arches, t the two diagonla arches and one transverse arch. Let A B be (28 bis) the face of the wall, C D the directrix of the transverse arch, D F the directrix of the diagonal arch; we trace the projection of the side arch as above. The diagonal arches determine the transverse arch. On each side of the line D E we lan off 067 ft. and draw the two parallels F G, H I, which give us the width of the diagonal arch. From the point H, the intersection of the line H I with the axis C D on that line H I, we take 4.44 ft, i.e., a little more than the depth of voussoirs of the diagonal arch, and we draw the perpendicular I G, which gives us the face of the diagonal arch. In the rectangle F G H I we trace the proper section. At both sides of the axis C D likewise taking 0.7 ft., we draw the two parallels K L, M N. From the point H laying off 1.4 ft. on the axis C D from H to C', we draw a perpendicular L N to that axis, which gives us the face of the transverse arch; we inscribe its section. At P we assume that the column supporting the si side arch extends above the imposts of the diagonal and transverse arches as before, that the section of the side arch extends vertically to the abacus of the capital. To trace this side arch in the last case, we take on the line A B 1.4 ft. f from the point M to Q, and from the point Q erecting a perpendicular to the line A B, we have the rectangle circumscribing the section of the side arch; the abacuses of the capitals a are traced parallel to the faces of the arches as shown by our Figure. From the angles G and L by drawing lines at 45° degrees, we cut the axis D E at O, which is the centre of the little column supporting the diagonal arch, and the axes C D at S, the centre of the column for the transverse arch; we t trace these columns according to the rule established before. Behind these detached columns are drawn the returns of the p pilasters that strengthen the pier; then the side arch R sta-

starts at the face of these pilasters bearing capitals like the columns.

Frequently the side arches do descend to the abacuses of the capitals of the great arches, and only have a little supporting column; they spring from a little column set on the lateral projection of the abacus, as indicated by Fig. 29 in plan and perspective. Then the abacuses of the lateral shafts A were cut so that their oblique face C D, perpendicular to the directrix 3 of the diagonal arches, was divided into two equal parts by that directrix.

Still it must be recognized, that the constructors only gradually decided to accent the form, the direction and the members of the vaults on the ground plan. They retained for some time the cylindrical piers in the ground story, tracing the plan required by the vaults only on the abacuses of the capitals of these piers. What preoccupied them from the end of t the 12 th century was the rigorous observation of a principle, which until then had not been imperatively accepted. This principle was that of the equilibrium of forces substituted for the principle of inert stability, so well applied by the Romans, and that the Romanesque constructors vainly endeavored to retain in their great vaulted edifices composed of several aisles. Recognizing the impossibility of giving to detached piers a sufficient bearing to resist the thrust of the vaults, the constructors of the 12 th century took a frank part; they sought their means of resistance elsewhere. They no longer d desired to accept the detached piers, except only as points of support maintained vertically, not by their own areas, but by the laws of equilibrium. It was then only important that they had sufficient strength to resist the vertical pressure. However, even when a principle is adopted, there are for a certain time in its applications, indecisions and experiments; men never free themselves on the morrow from the traditions of t today. Finding the cross vault or a square plan crossed by a transverse arch, the constructors sought again points spaced at alternate bays, more stable because of the principal thrusts. Indeed in Fig. 27, the points A receive the load and resist the thrust of a transverse and of two diagonal arches, w while the points B only receive the load and resist the thrust of a transverse arch. This system of construction of vaults,

adopted during the second half of the 12 th century, led the constructors to erect at the points A piers stronger than at the points B, then to give to the voussoirs of the transverse arches resting at A greater width and depth, than those given to the secondary arches; for in the primitive Gothic vaults, it is to be noted, as we have already stated, that the voussoirs of all the arches generally exhibit the same sections.

The pointed arch was so much required by the necessity for diminishing the thrusts of of resisting the loads, that we see in primitive Gothic structures, these arches are only adopted for the transverse arches and the lower archivolts, while the round arch is retained for the window openings, for arcades of galleries and even for sidi arches, that carry only a small load or have only a small span. At the cathedral of Noyon, w whose primitive vaults must have been erected about 1160, [1] the side arches of that epoch are round. At the cathedral of Sens, built about the same times, the side arches are round, [2] while the archivolts and transverse arches are pointed. It is the same in the choir of the abbey church of Vezelay, erected at the end of the 12 th century; the side arches are round. In these edifices and especially at Sens, under the thrusts and combined loads, [4] of the groin and transverse arches, the piers present a very considerable horizontal section compared to a cluster of little engaged columns; while under the load of t the transverse arch alone the piers consist of twin cylindrical columns set perpendicular to the axis of the nave. At Noyon the intermediate transverse arches rested on a single column before the rebuilding of the vaults. But the nave of the cathedral of Sens is much wider than that of the cathedral of Noyon, and the construction is stronger at all points. That a arrangement of the vaults, comprising two bays and carrying the thrusts and principal loads to the alternate piers, originally allowed the constructors to place flying buttresses only at these principal piers. It is probable that at the cathedral of Sens this was formerly the method adopted' perhaps it was the same at the cathedral of Noyon as at that of Paris. But these edifices having been more or less rebuilt in the 13 th century, it is impossible to affirm anything in that respect. What can be certain, is that at the end of the 12 th century the constructors had only adopted the flying buttress in des-

despair, that they sought to avoid this as much as possible, that they mistrusted this means, whose advantages and strength they had not been able to appreciate yet; that they regarded it as only an auxiliary, a last resource often applied af afterwards, and when they had recognized that they could not omit it. The best proof of this that we can give is, that some years later, the architects having subjected their system of vaults to the system of equilibrium, opposed flying buttresses ts the thrusts of vaults, which either were without them or had them only in part, and removed the flying buttresses of the 12 th century, probably badly placed or insufficient, to replace them by new and well combined buttresses with regard to resistance or pressure.

Note 1.p.49. These vaults were rebuilt in the 12 th century over the great nave, leaving the primitive side arches in place.

Note 2.p.49. These side arches were raised at the end of t the 13 th century, as may still be seen in the bays of the a apse.

Before proceeding farther, it is necessary for us to explain to our readers the procedures in construction, the nature and dimensions of the materials employed. We saw at the beginning of this Article how the primitive Romanesque constructors built their masonrw, composed of concrete comprised between facings of cut stone or pointed rubble. The constructors of the 12 th century made some modifications of these promary methods. Building edifices of greater extent and much higher than those of the Romanesque period, seeking to diminish the thickness of the internal supports and the walls, on the one hand it was necessary for them to find a method of construction more homogeneous and more resistant; on the other in monuments already of great height, to avoid the cost of labor, that the hoisting of materials of large volume would have occasioned. Therefore they renounced the use of masonry of large blocks (except in particular cases or in some exceptional edifices), and they preferred construction of small materials, retaining well pointed rubble rather than cut stone.

As much as possible, the greater part of the stones then e employed, forming facings, voussoirs and archivolts, of transverse and diagonal arches, are of sufficiently small dimensions to be carried up on a man's back and set by a mason like

our ordinary rubble. The method being adopted, this small masonry is very well executed and judiciously combined; it is a mean between the Roman construction with great masonry and that of concrete faced with bricks or rubble. In adopting small masonry for great edifices, the constructors of the 12 th century had too much sense to set these lower courses of little width with dry joints, like certain Roman structures, on the contrarw they separated these courses by beds and joints of mortar (0.4 to 0.8 in. thick), for these joints to form a connection between the internal mass and the facings. This was the Roman method, and it is good. One will indeed understand, that if (30) courses with dry joints are set before a mass of rubble and mortar, the mass tending to settle by the dryiug of the mortar under the load, and the stone courses set dry on each other not being able to diminish in volume, these will form a vertical rupture A B behind the facings, which will not delay falling. But if (30 bis) we have taken care to leave b between each course of stone a thick bed of mortar, this bed is connected with the mass and will not only retain the stone courses, but again it will permit them to settle equally with the settlement of the internal concrete.

The primitive Roman constructors, particularly iu provinces where may be procured large blocks of hard stone, as iu Burgundy, Franche-comte and Alsace, on the Saone and the Rhone, have not failed to imitate Roman masonry by setting wide and high slabs with dry joints before the concrete; but they also paid dear for this desire of making their construction other than it was. In most of these edifices appeared ruptures between the facings aud the concrete, longitudinal cracks, that occasioned in nearly all buildings at least serious disorders and frequently ruin. These effects were the more frequent and dangerous, as the edifices were higher. Better advised and t taught by experience, the architects of the 12 th centurw, as much by reason of economy and facility in execution, as to av - avoid this lack of homogeneity of the facings and the mass, a adopted construction by very low courses separated by thick beds of mortar. These beds not alone had the advantages of s settling and connecting the facings to the mass; made of mortar of fat lime, they hardened quite slowly, and awaiting perfect hardness, the construction had time to settle, to suffer

some deformations, without causing ruptures in the masonry.

The edifices erected from 1140 to 1200 in Ile-de-France, B Beauvoisois, Soissonais, Picardy, Champagne and Normandy, have such small masonry, that it is not surprising; for these edifices are already vast, complex in structure and yet very light. To use cut rubble in such structures as the principal material was great boldness; to succeed was the work of very skilful men. If we examine with care the masonry of the parts belonging to the 12 th century on the cathedrals of Noyon, Se Senlis, and of a great number of churches of Oise, Seine, Seine-et-Oise, Seine-et-Marne, Marne, Seine-Inferieure, etc., we are surprised that the constructors should have dared to build monuments of very great height and very light with materials appearing so weak, yet the stability of these edifices has long been assured, and if some of them have suffered visible changes, this nearly always refers to particular accidents, such as fire, lack of maintenance, or of loads added later. Of all these monuments, one of the most perfect and best preserved is the cathedral of Noyon, built 1150 to 1190. Except the little columns, the great capitals, the imposts and some exceptional pieces, the entire structure is really composed only of rubble of small resistance.

An idea of this construction will be received from our Fig. 31, that gives a part of the internal twin bays of the nave. The little detached columns of the gallery in the second story, those of the little upper triforium and those separating the high windows, are monolithic and of hard stone set on end. As for the small triple columns A, that before the reconstruction of the vaults in the 13 th century received the transverse arch of the intersection of the diagonal and side arches, they are composed of great blocks set on edge, retained by T cramps at certain distances. But these little columns were s set after the structure had settled, and since they are only a decoration and support nothing, the course of the capitals and the imposts whose ends engage in the masonry suffice to support the voussoirs of this transverse arch. We have indicated at B the springing of the old diagonal arches of the great vaults, and at C the side arch behind the diagonal arches. One will note that here as in most churches built at that epoch in the provinces adjoining Ile-de-France, notably in Beau-

Beauvoisois, the piers that support the imposts of the diagonal and transverse arches are much stronger than those supporting only the interdediate transverse arch. In other terms, (see plan), the piers B consist of a cluster of columns, while the intermediate piers E are only cylindrical columns in the ground story surmounted by the cluster - of little columns. The extreme lightness of such construction, the facility for cutting, raising and setting all the materials composing it, explains how, even with weak resources, men could thing of building edifices of great extent and very much elevated from the ground. Today that we have adopted the custom of employing enormous masses of great blocks of stone in our least important edifices, of using forces ten times as strong as necessary, we would not dare to undertake to build a cathedral of the d dimensions of that of Noyon with materials apparently so weax, and we snould spend fabulous sums to execute what one could do in the 12 th century with comparatively minimum resources. We find these structures expensive, because we are not willing to employ the procedures then in use. Yet the cathedral of N Noyon is standing after sevey centuries, and for a little proper maintenance it can endure still for five hundred years; now twelve hundred years seem to us to be a reasonable duration for an edifice, the great social revolutions to which humanity is subject taking care to destroy them, if they are b built to last longer.

Besides the advantages of economy, of facility in providing materials and of execution, constructions of small materials further perfectly suited the system adopted by the architects of the 12 th century. Those light structures producing in plan on the ground an area of solids of small extent with regard to that of the voids, subject to oblique pressures and the laws of equilibrium replacing the Roman laws of inert stability, required in all the members composing them a certain elasticity. Where the constructors were less permeated by the new p principles then adopted, and sought to reproduce the forms, t that the lay artists of the 12 th century had adopted, without accurately knowing the reason for employing materials of great dimensions, there were produced in the structures such ruptures, that equilibrium was sonn destroyed. If the arches were not perfectly independent of each other; if at one point had

been placed materials of high layers, and if beside them this construction was only built of stones of small size, the parts too rigid, too much bonded with the mass, or too heavy, presented a resistance with no result other than to cause ruptures and cracks; the too solid parts of the structure crushed or dragged over the weak parts. Let us again observe, that in the monuments the piers of small horizontal section received the entire load, and that even by reason of the small area of their bearing, they must settle much more than the walls, for example, which supported nothing, since they were even relieved of the weight of the roofs and upper masonry by the side arches. If in this system there is a complete stability of t the loaded parts of the fillings, the enclosures and walls, that are not loaded, it is necessary for a rupture to occur. But on the contrary, if constructors have taken care that all loaded parts retain an independent function, they can move a and settle freely; if the accessory parts of only enclosures independent of the effects of pressure or thrust, these ruptures cannot occur, and the disconnections favor the duration of the construction instead of being injurious to it.

The Romans only opposet passive resistances to thrusts, but had accepted fully this principle of disconnection, of freedom of parts loaded by vaulted construction and those not so loaded. The great halls of the antique baths are masterpieces in that kind of combination. The entire system consists of piers supporting vaults, the walls are merely enclosures built afterwards, that could be removed without injuring in any wise the stability of the general framework of the structure. These are very natural and simple principles; why not always put them in practice? Gothic constructors carried these principles much farther than the Romans had done, because as we have said many times, they had adopted a system of construction in which every force is active, and where there are no inert resistances acting by their compact mass, as in Roman construction.

The constructors of the 12 th century, in erecting their g great edifices on plans, where the solids covered little area, and with light materials; in opposing to oblique thrusts active resistances instead of passive obstacles, were not long in perceiving, that it was always necessary to find somewhere this inert stability. If they built flying buttresses against

the surfaces of vaults at the points of their thrusts, these flying buttresses must find an immovable bearing, to effectively fulfil their part; that bearing was the external buttress, a sort of pier erected outside the edifice, on which were resolved all thrusts. To give these buttresses a horizontal section sufficiently large to preserve the immobility of their mass at a great height, was to encumber the exteriors of the edifices by heavy masonry intercepting air and light, and which became very costly. Constructors no longer had the recipe of those Roman mortars, the principal agent of their great s structures; that piers that they could have built would not have had the necessary cohesion. It was then necessary to find the means of substituting for the passive resistance of the Roman points of support, a force equally powerful but derived from a different principle. This means was ts load the points of support destined to resist the thrusts until they had attained sufficient weight to resist the action of those thrusts. It is not necessary to be a constructor to know that a prismatic or cylindrical pier, composed of superposed courses and with a height more than 12 times its diameter, cannot be maintained standing, if it is not loaded on its top. That law of statics being well known, the Gothic architects believed that they had found the means of erecting edifices, whose points of support might be slender, on condition of loading them w with a weight capable of rendering them sufficiently rigid to resist oblique and opposing thrusts.

Indeed, assume a pier A B (32) subject to two oblique thrusts C D, E F, opposed and acting at different heights; the greater thrust C D being = 10 and E F = 4. If we load the top B of the pier with a weight = 12, not only is the thrust C D neutralized, but for a stronger reason also E F, and the pier will remain vertical. Not being able to load the piers of naves with a weight sufficiently great to neutralize the thrusts of the great vaults, the constructors resolved to oppose to the thrust C D a flying buttress G. Hence the weight B C increased by the pressure C D becoming = 15, for example, the thrust E F is neutralized. If the flying buttress G opposes this oblique thrust C D by .n equal resistance, and completely neutralizes it, the thrust C D becomes a vertical action on the pier A B, and there is only the need to support the

oblique action of the flying buttres on the external buttress. Now if that external force itself = 8, it is not increased by the total amount of the thrust C D, but only by a small part of that thrust, it is 10 or perhaps 12 in certain cases. The external buttress H already opposing by its own mass a resistance = 8, it will suffice to load it by the weight K = 5, to maintain the general equilibrium of the structure.

We shall refrain from solving these questions of equilibrium by algebraic formulas, that practice continually modifies, because of the nature of the materials employed, their height of courses, quality of mortar, resistance of the ground, the action of external forces, the more or less care taken in the construction. Formulas are good for showing the knowledge of their maker; they are almost useless to the practician; he a allows himself to be directed by his instinct, experience, ob observation and that feeling innate in every constructor, that indicates to him what is necessary to do in each particular case. We do not hope to make constructors of those to whom n nature has refused that quality, but to develop the instincts of those possessing it. Good sense and reason are not taught, but one may learn to use the one and listen to the other.

The study of Gothic construction is useful, because it has not adopted those absolute formulas, always neglected in the execution by the practician, whose least danger is to cause error to be accorded the confidence, that alone should be inspired by facts.

If Gothic construction be not subject to absolute formulas, it is the slave of certain principles. All its efforts and i its perfecting tend to convert these principles into laws, and it obtains as a result equilibrium; compressile forces o opposed to forces of tension; stability obtained by loads reducing the various oblique forces to vertical loads; as a result is the reduction of the horizontal sections of the points of support; such are the principles, and these are still those of true modern construction; we do not speak of that blindly seeking to reproduce edifices erected in conditions foreign to our civilization and our needs; but of the construction required by our modern needs, or state of society. If Gothic c constructors had had at their command cast iron in large masses, they would have enthusiastically taken possession of this

means of obtaining points of support as slender and as rigid as possible, and perhaps they would have employed it with more skill than we do. All their efforts tend to equilibrate f forces, and to only regard points of support farther as posts maintained vertical, not by their own sections, but by the c complete neutralization of all oblique forces acting on them. Do we act differently in our private structures, in our great establishments of public utility? where the requirements are so imperious, that they silence the routine of instruction? And if a fact should surprise us, is it not to see today in the same city the erection of houses, markets, railway stations, warehouses, supported on columns and covering large areas, leaving to the solids a section scarcely appreciable, and at the same time edifices in which stone accumulates in profusion blocks piled on blocks for covering relatively small a areas, only supporting floors exerting no oblique pressure? Do not these facts indicate, that architecture is out of the path traced for it by our needs and our modern engineering? That it seeks to protest vainly against these needs and this engineering? That the time is not distant when the public, oppressed by an art that claims to free itself from its tendencies under the pretext of maintaining classical traditions, for which it cares little, will class the architect among archaeologists, good for enriching our museums and libraries w with their learned compilations, and to amuse some assemblies with their sterile discussions? Now we repeat, that Gothic construction, in spite of its defects, errors, and research, and perhaps because of all that, is an eminently useful study; it is the surest initiation into this modern art, which does not exist and seeks its way, because it establishes the true principles to which we must again submit ourselves today, because it broke with antique traditions and is fertile in application. It is of little importance that a turret is covered by ornaments not in the taste of a certain school, if this turret has a reason for existence, if its function be necessary, if it allows us to occupy less space on the public way. It is of l little importance that the pointed arch shocks the eyes of the exclusive partisans of antiquity, if this arch be more stable and more resistant than the round arch, and saves us a considerable volume of stone. It imports little that a column has

twenty or thirty diameters in height, if this column serves to ca ry our vault or floor. In an art entirely of convention and reasoning, the beautiful is not eternally fixed to a single form; it can always be where the form is only the expression of of the need fulfilled, of the judicious use of the g given material. Because the multitude sees in Gothic architecture only its ornament, and that ornament is no longer of our time, is this a proof that the construction of those edifices cannot find its applications? It would be just as well to assert that a treatise on geometry would be worthless because printed in Gothic characters, and that students reading in t that book, that angles opposed at the vertex are equal to e each other," only learn nonsense and are misled. Now if we co could teach geometry with books printed yesterday, and could do the same for construction, it is necessary to seek the principles where they are traced in the monuments, and this book of stone, however strange its types or its style, is worth indeed as much as another in reality, as well as for the thought that dicatated it.

In no other architecture do we find those ingenious and practical means of solving the numerous difficulties, that surroound the constructor living in the midst of a society, whose needs are excessively complex. Gothic construction is not like antique construction entirely in one piece, absolute in its means; it is flexible, free and searcheng like the modern spirit; its principles allow the application of all materials f furnished by nature or industry, according to their proper q qualities, it is never stopped by a difficulty and is ingenious; this word says everything. Gothic constructors are subtle, ardent and indefatigable workers, reasoners, full of resources, never stopping, free in their procedures, desoring to posses s novelties, all qualities or defects that place them at the h head of modern civilization. Those constructors are no longer monks subject to rule or tradition; they are laymen that analyze everything, and recognize no law but reasoning. Their faculty of reasoning scarcely stops before natural laws, and if they are compelled to accept these, it is to conquer them by opposing them to each other. If that is a defect, is it fitting for us to reproach them with it?

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necessary to make understood the sense of the constructions of which we shall present numerous examples. Knowing the tendencies, the independent minds of Gothic constructors, their patient labors in the midst of a society scarcely commencing to be formed, our readers will better appreciate their efforts, and the feeling that produced them. Perhaps like us, they will find in those bold innovators, bold modern engineering, distracted but not suffocated by routine and prejudices of the spirit of the system, by exclusive doctrines.

In commencing this Article, we have seen that if Roman construction is in all parts excellent, wise and coordinated, 1 like the social constitution of that people, once discovered it marched safely in the same path, invariably following the same laws and employing the same means of execution until the end of the late empire. That was good, admirable, but it could not be transformed. The principal force of the Roman people was to preserve its social constitution in spite of the most evident symptoms of dissolution. Its architecture proceeded similarly; one sees under the last pagan emperors that the e execution degenerates as well as taste; but the construction remains the same, the Roman edifice is always Roman. Except the spherical vault on pendentives which belongs to Byzantium, when the Roman empire nears its end, there is no progress, no transformation nor effort. The Romans built as bees make their cells; that is marvellous; but the hives of today are filled just like the hives of the time of Noah. Give to the architects of the baths of Titus cast iron, urought iron, sheet iron, wood and glass, and require them to make a hall, and they would say to us that they could construct nothing with these materials. modern engineering is different; require it to erect a hall op 66 ft. span with pasteboard, and it would not tell you, that the thing is impossible; it would experiment and envent means to give rigidity to pasteboard, and we can be assured that it would erect the hall.

The Roman traces the plan of his edifice with great judgment; he takes the foundations necessary and proceeds with assurance; no anxiety during the execution; he is certain of the result foreseen in advance, as he has taken all required precautions, and he raises his structure with security, nothing being able to oppose his projects; he has known how to avoid all contin-

contingencies, and sleeps tranquilly while his edifice rises on its immovable foundations. What is further lacking to him? Place? He takes it. Materials? He finds them everywhere; if nature refuses them, he makes them. Men, transportation, money? He is master of the world. The Roman is a superhuman being; he has something of the measured greatness assigned to the Deity; nothing can restrict his power. He builds as he wishes, at the place he chooses, by the aid of men blindly subject to him. Why should he create at pleasure difficulties for himself? Why invent machines adapted to raise the waters of rivers to a great height, since he can seek their sources in the mountains and bring them into the city by a natural s slope across vast plains? Why struggle against the regular o order of things of this world, since this world, men and things are his?

The error of the first times of the middle ages was to believe, that in the state of anarchy into which society had fallen, one could do again what the Romans had done. Thus while that epoch of transition followed the traces of Roman traditions, what lack of power and poverty! But there soon arose the spirit of modern society, to this vain desire to revive a dead civilization succeeds antagonism between men, a struggle against the material. Society is subdivided, the individual is responsible, all authority is contested, because all powers neutralize each other, combat and are victorious in t turn. Men discuss, seek and hope. Among the remains of antiquity, it is not the arts that are exhumed, but philosophy and the knowledge of things. Already in the 12 th century, to Greek philosophers the select minds went to seek their arms. Th Then this society, still so imperfect and miserable, is in t the true path; its instincts serve it well; it takes from the remains of the past what can enlighten it and make it advance forward. The clergy vainly struggled against these tendencies; in spite of all the power at the disposal of clerical feudalism, it was itself carried away by the movement; it daily saw born around it the spirit of examination, discussion and criticism. Besides at that epoch, everything to weaken one power is supported by a rival power. The national genius skilfully profits by this rivalrw; it forms and emboldens itself; always materially dominated, it makes itself morally independent,

pursues its own course through the struggles of all these powers, still too little enlightened to require from the intelligent multitude that arises, anything but material submission. Many others before us have said with more authority, that the political history of great powers, such as formerly wns made, presents but a narrow side of the history of nations; illustrious authors in our time hav shown, that one cannot know the life of the people, their developments, the causes of their t transformation and of their progress, only by seeking in their onw bosoms. But what has not yet been made is the history of those live, active and intelligent persons, strangers to politics, war and traffic; who about the middle of the middle ages assumed such a great part in the country, of those artists or artisans, if one prefers, formed into guilds; obtaining privileges extended by the need of the services rendered by them; laboring in silence, no longer beneath the vaults of cloisters but in the workshops; selling their material labor, but retaining their independent ind inventive genius; ke keeping closely united and marching together toward progress, in the midst of society that used their intelligence and their hands, without understanding the liberal spirit that animated them.

Let others understand a task merely traced here by us; it is fine and made to arouse sympathy, it embraces questions of the highest order; it will perhaps illuminate certain problems set in our days, and that occupy not without cause clea.esighted minds. To know well the past, we believe is the best means of preparing for the future, and of all classes of society, that whose ideas, tendencies and tastes vary least, is certainly the working class, that produces. In France this class demands something more than its daily bread; it requires the satisfaction of its self-love; it demands the preservation of its individuality; it desires difficulties to be solved, for its intelligence is still more active than its hands. If necessary to occupy it materially, it is also necessary to occupy it morally; it desires to understand what it does, why it does so, aud that men are grateful ts it for what it has done. All admit that this spirit prevails among our soldiers and en-ensures their success; they why not recognize that it is in our artisans? To speak only of buildings, workmanship has dec-

declined among us during epochs in which men have claimed to subject individual labor to some classical rules established by an absolute power. Now when workmanship declines, social crises are scarcely be be expected in France. Of all industries, that of building certainly occupies the greatest number of men, and demands from each a very high degree of intelligence. Masons, stonecutters, lime-burners, carpenters, joiners, iron smiths, roofers, painters, sculpturs, cabinet-makers, upholsterers, and the subdivisions of these various trades form an innumerable army of workmen and artisans, acting under a si single direction, very much disposed to submit to it and even to aid it when enlightened, but soon without discipline when that direction is opposed to its own genius. Our workmen and artisans only listen to and follow those, who can tell where they are going and what they want. Why is always in their mouths or in their eyes? there is no need for remaining long im the midst of workmen on buildings to learn with what sarcastic indifference they work on things, whose reason for existence they do not understand, and with what attention they execute works whose public utility they see. A stonecutter does not dress with the same care the block of stone, that he knows will be concealed in a mass, such as he will dewote to cutting a stone to be seen, whose useful function is known to him. Every request of the master of the work can effect nothing against this feeling. It is perhaps an evil, but it is a fact easily proved in the work-yards. Appearance is the common weakness in France' not being able to conquer it, it must be u utilized. Some desire us to be Latins, perhaps by language; we are nowise so in manners and tastes, character and genius, no more today than in the 12 th century. Cooperation in a common work is active, devoted and intelligent in France, when one knows that this cooperatiou, however will consequently a appear to be appreciated. it is weak, idle and careless, when it is supposed to be lost in the general mass. We beg our readers to become permeated with this natural spirit, too long disregarded, in order to better understand the sense of the examples, that we shall successively place before their eyes.

To become familiar with an art whose resources and practical means have been forgotten, it is first necessary to enter into the spirit and intimate feelings of those to whom that

art belongs. Then all is naturally deduced, all belongs together ind the aim clearly appears. Further we do not pretend to conceal any of the faults of the systems presented; this is not a plea in favor of Gothic construction that we make, it is a simple statement of the principles and their consequences. If we are well understood, there is not an intelligent a architect, that after having read our work with some care will not recognize the uselessness, to say no more, of imitations of Gothic art, but who will not also understand the benefit he can derive from the serious study of that art, the innumerable resources offered by that study, so intimately connected with our genius.

We shall continue the examination of the great religious st structures, first because they are the most important, then because they rapidly develop at the end of the 12 th century, and because the principles by which these edifices arise are applicable to all other construction. We now know the successive phases by which the construction of vaulted edifices must have passed from the Roman to the Gothic system, in other words, from the system of passive resistances to the system of active resistances. From 1150 to 1200 were built in the royal domain, in Beauvoisois and Champagne, the great churches of Notre Dame of Paris, Mantes, Senlis, Noyon, S. Remy of Rheims (choir), Sens and Notre Dame of Chalons-sur-Marne, all after the new principles adopted by the lay school of that epoch, all having retained perfect stability in their principal works.

VOUTES. Vaults.

In all things experience and practice precedes theory, the fact precedes the law; but when the law is known, it serves to explain the fact. One observes that all bodies have weight and that a force attracts them toward the centre of the globe. Men still knew nothing of the weight of the atmosphere, of t the force of attraction, of the form of the earth; they only knew that every heavy body, if left to itself, was attracted vertically toward the ground. From the observation of the fact are deduced precepts, whether the principles are ture or false, that changes nothing in the nature of the fact nor in its recognized effects. The constructors of the 12 th century had not defined the laws to which are subject the voussoirs of t

an arch, viz:-- their weight and the reactions of the dajoining voussoirs. We know know by theory, that if one seeks on each bed the point of the passage of the resultant of the pressures exerted there, and that if one passes a line through all these points, a curve is determined, called the curve of pressure. We also discover by the aid of algebraic calculations, that if the equilibrium of the voussoirs of an arch is to be perfect, it is necessary that this curve of pressure, whose first element at the keystone is horizontal if the arch be semicircular, must not pass outside the lines of the intrados and extrados of that arch. This curve of pressure extended below that arch, when it is supported on piers, determines w what is called the thrust, then the more the arch approaches in elevation the horizontal line, the more the thrust differs from a vertical; the more the arch varies from the horizontal line, the more the thrust approaches the vertical. Gothic constructors only had the instinct for that theory. Perhaps they possessed some of those mechanical formulas, that one still finds indicated in the Renaissance authors, who have treated of these matters, and which they do not give as discoveries of their time, but on the contrary as traditions proper to fo follow. For example, relating to the thrusts of arches, men still employed in the 16 th century a very simple geometrical method for estimating the strength to be given to abutments.

Here (32 bis) is that method; let an arch have the diameter A B, according to the nature of that arch what should be the thickness of the piers capable of resisting its thrust? We d divide the semicircular or pointed arch into three equal parts A D C B; from the point B as centre describe a circular arc with radius B C. We prolong a line through the points C and B; its intersection E with the arc described from B as centre, will give the external face of the pier with a thickness equal to G H. If we proceed in the same manner for pointed arches, always dividing them into three equal parts, we shall obtain thinner piers, the more acute are these arches, as our figures show. It is understood that this procedure is applicable only when the arches are placed on abutments of equal heights for these different arches, and which are not more than 1.5 times the diameter or span of these arches. It is probable that primitive Gothic architects had very simple rules for ordinary

cases; but it is certain that they resorted to their judgment alone always, when they had to solve some new difficulty. As if they had determined the laws of pressure of arches, they arranged to concentrate on the course of these lines the pressure of resistant materials, and thus conducting the thrusts from the summit of vaults to the ground, they successively came to regard everything outside as useless and suppressed it.

We disire to be understood by all; we do not therefore restrict ourselves to definitions. Let A B be the curve of pressure of the voussoirs, B C being the thrust; if the wall supportr a tunnel vault at the height F D, its thickness must pe C D. The entire oblique thrust of the vault acting at the point C, what is the use of the structural triangle E D F? Now assume that we have a Gothic pointed cross vault (34); the resultant of the three oblique pressures B A, C A and D A in p plan combines in the line A E; in a line G H in the section. The feeling of the constructor indicating to him the principle, he will make all his masonry construction discharge; i.e., receding from the vertical support I O, he will set a capital M, whose projection will meet the direction of the thrust G H. At O he will also have a corbel and at I a discharging capital, so as to bring as nearly as possible the axis P of the l lower column to the point H, the point reached by the thrust G H. But being forced in edifices with three aisles to leave this point H outside the axis of the column, he only regards that as a point of support necessary to maintain vertical by equilibrium. He therefore neutralizes all lateral force by constructing the flying buttress K. But one will object, why retain discharging masonry from the moment that the thrust of the great vault is neutralized by the pressure of the flying buttress? There appears the acuteness of the constructor. That thrust G H is neutrailsed but still exists; it is an opposed force, not supported. The flying buttress prevents the effects of the thrust; this is its sole function; it does not destroy the oblique force. Do not forget that there exists a lower v vault L, whose thrust can only affect the column P, and that this thrust can only be suppressed by the vertical load exerted by the construction from R to S, that this vertical load will have the more force when it is increased by the thrust of the great vault, and that the intersection of these two

vertical and oblique forces at S, a single point of the capital, it will precisely come to abut the thrust exerted by L S. To determine these forces by calculation would be merely lost labor, for these calculations must vary infinitely by reason of the heights or voids, the thickness of the solids, the quality of the materials, their resistance, the heights of courses, etc. But always human instinct, when it is sharpened, i s more subtle than calculation; just as no machine, however perfect, attains the delicacy of the hand and the certainty of the eye. In this case the feeling of the first Gothic constructors served them well; for all naves elevated on cylindrical columns, arranged as indicated in our section (Fig. 34), are rarely deformed in a sensible manner; while most of those whose piers are composed of groups of little engaged columns and rise from the ground, are bent more or less because of the t thrust of the lower vaults. But we shall have occasion to return to this later.

This first point explained, we now come to the details of the execution; that is essential. Gothic construction proceeds (if it be permitted to employ this comparison) from an organic system much more complex than that of Roman construction. "So much worse," say some, "that is a mark of inferiority." "So much the better," say others, "that is a proof of progress." progress or decadence, this is a fact that we must recognize and study. Already our Fig. 34 shows that the combination by means of which the thrusts of vaults are resisted in Gothic construction are nothing less than simple. Now all construction proceeding from a complex principle involves a series of consequences, that cannot be simple. Nothing is imperatively logical like a building erected by men reasoning on what they are doing; we shall soon recognize this. The choir of S. Remy of Rheims was rebuilt about 1160, at the time when was erected that of the cathedral of Paris. This structure, very skilfully conceived in its entirety, shows in its details only a series of experiments; which indicates a school already advanced theoretically, but very little experienced in construction. The principles of balance and of equilibrium, that we have traced above, are applied here with rigor; but evidently workmen and foremen were lacking to those first Gothic architects; th they had neither had time nor means for training skilful work-

workmen; they were not understood. At most, the choir of S. Remy of Rheims must with reason arouse the admiration of the constructors of the end of the 12 th century, for the methods adopted there are followed in Champagne at that epoch, notably in the rebuilding of the choir of church of Notre Dame of Chalons-sur-Marne.

But let us first briefly trace the history of that charming edifice. The church of chalons-sur-marne was built during the first years of the 12 th century; it was then composed of a n nave with side aisles, the nave was probably covered by carpentry resting on transverse arches, like many churches of that epoch and of Champagne, the side aisles were vaulted by means of transverse arches separating Roman cross vaults. The choir was composed of an apse without side aisles and with two square chapels opening into the transepts beneath two towers, l like the cathhdral of the same city. About the end of the 12 th century (although this monument was erected under excellent conditions, and nothing causes the supposition that it had suffered), these arrangements were no longer in harmony with the ideas of the time; vaulted naves were then desired, side aisles and radiating chapels around the sanctuary. This church was then subjected to a complete rebuilding; the circular wall of the apse was replaced by detached columns, a side aisle was erected giving entrance to these chapels or little circular apses, they retained the two towers flanking the apse, but re removed the rear wall and the square chapels arranged beneath these towers, and these served for communication with the side aisle of the chevet. The nave was raised and completely vaulted; instead of the Roman vaults of the side aisles were built cross vaults. Some capitals coming from the demolitions were replaced, notably in the side aisle of the apse. This h historical summary shows how men were then disposed to profit by all resources presented by the new system of architecture, scarcely yet sketched. The construction of the apse of the c church of Notre Dame of Chalons-sur-Marne is very little later than that of the choir of S. Remy of Rheims, but it is already more skilful; one finds there still many experiments, and still the advance is sensible.

We must here resume preceding matters. We have described the simple cross vault between parallel walls, and we have

indicated the first efforts of architects to construct it and maintain it on its piers. It is necessary for us to return on our steps to examine the varieties of these vaults.

From the 11 th century men had already surrounded the sanctuaries of churches by side aisles with or without radiating chapels. (Art. Architecture Religieuse). This method was foreign to the plan of the primitive basilica, and had caused t the constructors more than one embarrasment. Roman antiquity left nothing like it. The Romans certainly had built porticos on a circular plan; but these porticos (if vaulted) were composed of thick piers supporting an annular vault penetreted by half cylinders forming cross vaults, or a series of radiating tunnel vaults placed on arches or even on jointed platbands, as may yet be seen in the amphitheatre of Nimes. But the Romans had not had the idea of placing cross vaults on p porticos formed of detached cylindrical columns, for that could not accord with their system of inert stability. What the Romans had not done, in that as in many other things, the constructors of the Romanesque epoch attempted. They desired to surround the sanctuaries of their churches by porticos or side aisles concentric with the curve of the apse, and to open these porticos as much as possible by supporting by detached columns the vaults that must cover them. Primitively, as for example in the churches of Auvergye and Poitou, they were satisfied by an annular vault, intersected by arches turned by one column to another. To abut the thrust of these annular v vaults toward the interior, they first counted on the loads resting on the columns, then on the circular form of the apse, which opposed great resistance to these thrusts. Thus are vaulted the side aisles of the apses of the church Notre Dame-du-Port at Clermont, Issoire, S. Nectaire, S. Savin near Poitiers, etc. Frg. 35 explains this method without the need of more extended developments. [1]

Note 1.p.67. Side aisle of the choir of Notre-Dome-du-Port at Clermont.

But when during the 12 th century the constructors had introduced the system of cross vaults, they naturally desired to apply it everywhere, and they thought with reason, that it w was not possible to retain in the same edifice the method of Roman cross vaults beside the new system. Since it was easy

to place on the oblong abacus of the capitals A the imposts B cut so as to receive a simple cross vault, that became just as difficult when the cross vault comprised transverse arches and diagonal arches. Theat difficulty was not the only one. If we represent a part of the plan of the apse of the church of Notre-Dame-du-Port with its side aisle (36), we see that the intersections of the half cylinders A and B with the annular vault C C′ give in horizontal projection the two grain lines E F, G H. Note that the aisle being circular in plan, the opening H F is greater than the opening E G; that if we erect a round arch on H F and another on E G, the latter will have its crown much lower than the former; that the intersection by the half cylinder with diameter E G in the annular v vault C C′ will trace in horizontal projection the line E′L G′, and that consequently it will not be a cross vault but simply the intersection of a small cylinder with a large one. To obtain a cross vault E F G H the constructors then stilted the round arch traced on E G, as indicated by its revolved positi - ou I K M, taking a height N M = the rise O P. Thus the abacuses of the four engaged and isolated columns R,S,T,V being on the same level, the two crowns were on the same horizontal l line, which determined the rise of the annular vault C C′. T The idea of stilting the round arches turned on the detached columns T, V was not a caprice, a barbaric whim, still less an oriental imitation, as sometimes claimed, but the result of a very simple calculation of the constructor.

This first step being taken, let us see how the architects of the 12 th century attempted to proceed farther in placing the cross vault on a circular plan. Do not forget that one of the motives, that had caused the adoption of the cross vault was to free themselves from certain oppressive necessities i imposed by the antique cross vault, the need of independence felt by constructors. But independence in construction as in everything is only attained by a series of abortive trials. The architects of the 12 th century strongly felt that their principles were fruitful in application, that they led to surmounting without effort the difficulties of the construction of great edifices; however as always happens, these both so simple and flexible principles, embarrassed them cruelly in direct application; to remain faithful to them they made their

constructions complex, they could not entirely get rid of old traditions, and desiring to harmonize them with their new ideas, they fell into infinite difficulties. Yet far from being discouraged, after each attempt they adhered to these new ideas with the ardor and persistence of convinced men. We shall see them at work in the cathedral of Langres, one of the monuments of France most fertile in construction, and certainly one of the best built. Those antique traditions had a considerable power; Langres is a Roman city in a country covered a few centuries since by numerous Roman edifices nearly intact. Let us reach the fact that especially occupies us, cross vaults turned over the side aisle of the sanctuary. The cylindrical column, that remained so late in even purely Gothic edifices, is employed in the choir of the cathedral of Langres. These columns have the proportions of the Roman Corinthian column, and their capitals are quasi-Roman; but (37) their abacus is already arranged with the view of what it must bear; two of its sides are not parallel and form a wedge to avoid warped surfaces in the intrados of the archivolt A that they support; at the side next the side aisle this abacus forms a broken l line to offer a projecting point of support to the transverse arch B. At X we give the horizontal projection of this abacus. Feeling the necessity of disengaging the transverse arches, and leaving a place for starting the diagonal arches, and fearing the action of the thrust of the vaults on the columns, in spite of the circular form of the apse, the architect placed on this abacus a projecting corbel C. As shown by our Fig. the groin arches D spring with difficulty; yet the instinct of the artist decorated the springiug so as to disguise its slenderness. There are three voussoirs on each other; the two first E, F have their beds horizontal, the third has the joints normal to the curves of the arches. Then these arches with difficulty are disengaged from the square plan, and even the groin arch must be inserted between the voussoirs of the archivolts of the transverse arches. But the constructor already desired to cover his archivolt by a second arch I, that penetrates t the groin arch, for the wall is thick over these archivolts ; it supports a spherical vault. It is then only above the groin arch, and when this separates from the voussoirs, that a second arch I could be turned. This is not all; these vaults be-

being radiating, the architect has traced his diagonal arches in horizontal projection as indicated in Fig. 38; the surface K L M N being a trapezoid, and the constructor not yet supposing it possible to trace diagonal arches forming broken lines in horizontal projection, the crown O is nearer the line M N than the line K L. The arch K L having its crown at a higher level than that of the arch M N (for he did not dare to stilt the latter), the line R S is inclined from R to S. Our Fig. 37 will sufficiently make this arrangement understood, and the section (39) explains it still better. Besides a construction of this kind, whether intended or produced by chance, presents advantages; it allows the light received under the side arches of the vaults of the side aisle to plunge into the midst of the sanctuary; it does not lose uselessly the height of the inclined roof A; the inclination of this roof and that of the vault give a place for the gallery B; further, it offers great resistance because it transfers a considerable part of the loads and thrusts to the internal cylinder, which forming a vault does not risk separation by slices and departing from the centre. At Notre-dame-du-Port the abacuses of the capitals (Fig. 36) form parallelograms in plan, so as to offer a sufficiently thick bearing for the walls of the sanctuary; it results from this that the stilted arches on these abacuses present warped surfaces and cones rather than half cylinders. At the cathedral of Langres the abacuses of the capitals are traced in wedge form, as we have stated, so as to preserve f for the intradoses of the archivolts curved surfaces, that a are exactly parts of cylinders. Thus is avoided a difficulty in stonecutting and warped surfaces disagreeable to the eye, but the abacuses in wedge shape make the capitals ungraceful; seen parallel to the diagonals, they give on the side next t the side aisles an angle projecting more than on the side next the sanctuary. The architects of the Gothic school soon freed themselves from this embarrasment, and knew how to avoid these difficulties.

Our readers will see at once why we have enlarged on the t tracing of the manner of constructing the radiating vaults of the side aisles of apses. One word more before coming to the improvements introduced by the Gothic architects. These at f first had adopted two methods to neatralize the thrusts of v

vaults; the first method was that consisting of resisting the effects of these thrusts by a force acting in the opposite s sense; the second, termed the preventive method, consisted in destroying these effects at their origin, i.e., by preventing their action. Then they employed one or the other of these m methods as needed; sometimes they profited by the efforts of thrusts without allowing them to destroy the general equilibrium, as we have seen in Fig. 34; sometimes neutralized these and reduced them directly to a vertical pressure.

A very simple drawing will cause the application of these two methods to be understood. Let (40) be a vault whose resultant thrust is the line A B, then can we establish a structure as given by our sketch. Assuming the stones C, D to each be a single block, resistant and built into the buttress, this construction will be more stable, than if we had erected a p pier E A from the ground to the impost of the vault. In this Fig. we profit by the effect of the thrust A B, and we support according to its direction. The flying buttress G and its mass are there only to prevent the vault from spreading horizontally. Let us note in passing, that the flying buttress does not load the pier X, and that it only presses against the vault at the point where the curve of pressure tends to leave the extrados of the voussoirs. That is the method of restraining the effects of the thrust, but using it as an element of equilibrium. Now (40 bis) let this be the vault, the resultant thrust being the line A B. If instead of a flying butterss we oppose to the thrust a less powerful thrust C D, and we place a load E on the imposts of the two vaults, we shall reduce the oblique thrusts to a vertical load, preventing the effects that do not act. This is what we term the preventive method.

There is then something very subtle in these constructions:- 1, that the flying buttress is simply an obstacle opposed, not to the oblique pressures, but to their effects, if the e equilibrium may be disturbed; 2, that it allows the constructor to profit by these oblique pressures in his general system, without fearing to see the economy of that arrangement disturbed by the beginning of an action outside the equilibrium. But the entire attention of constructors even by this t tends to the perfect stability of the buttresses receiving the thrusts of the flying buttresses, for the equilibrium of the

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forces of the various parts of the edifice depends on the stability of the external abutments. Still the architects did not desire or often could not give to these abutments a sufficient thickness according to their height; then it was necessary to fix them by artificial means. We have an example of the use of this means in the church of S. Remy of Rheims, more frankly emphasized again in the choir of the church of Notre-Dame-of Chalons, to which we return.

We first present (41) the plan of one bay of this apse, at A in the ground story, at B at the height of the vaulted gallery of the second story, at C at the height of the triforium, and at D at the height of the springings of the vaults. On t the plan of the ground story is to be seen how the architect spared himself the embarrasment of constructing a pointed vault over a trapezoim. He placed at the entrance of the chapels columns E, that allowed him to trace a vault E F G on a parallelogram. Then the transverse arch E H is similar in height and span to the transverse arch F I, and the line of the crown I H of the triangular compartments is not inclined as at Langres, from the exterior to the interior. From E to K a second transverse arch connects the column E to the pier K, and there remains a triangle K E F easily vaulted, since it is only a portion of of an ordinary compartment. The method is the same as at S. Remy of Rheims, but not as well applied. It is seen that these upper plans rest exactly over the ground story, u unless there is some overhang, whose necessity we shall at i once recognize.

In the construction of the choir of Notre Dame of Chalons, there is an importent fact,because indicating the efforts attempted by the master of works to free himself from certain difficulties, that greatly embarrassed his colleagues at the end of the 12 th century. It will be observed, that the plan of the sanctuary is polygonal in the interior of a semicircle on the exterior. Thus the lower archivolts L connecting the great great columns of the ground story are turned over the sides of a dodecagon, while the archivolts of the gallery of the second story are on a rectilinear plan at the sanctuary, and a curved plan at the gallery; the external wall of that gallery is likewise built on a semicircular plan, and the triforium (plan C) is on a rectilinear plan inside, and a curved

plan outside. It is the same with the upper windows (plan D). The architect desired to avoid the embarrasment produced by the construction of archivolts or transverse arches on a semicircular plan of quite small radius. He feared the thrusts to the exterior, and retaining the circular plan only on the exterior and bringing it to a dodecagon in the interior, he very skilfully combined the advantages of both systems; i.e., the main lines of the walls and concentric bands, a simple a arrangement outside and with great stability joined to a satisfying effect in the sanctuary; for the arches pierced in a wall on a circular plan of small diameter always produce lines very disagreeable to the eye.

We now give (43) the section of this construction up to the vaults on the line M N of the plan. This section shows us at A, according to the method then employed in Ile-de-France and the adjacent provinces, the cylindrical columns marked O in the plan; at B is the archivolt and the omission of the vaults of the side aisle. Important churches of that epoch and p province all have a vaulted gallery in the second story.(Arts. Architecture Religieuse, cathedral, Eglise). Here the vault is rampant, like that of the side aisle of the cathedral of Langres, not possibly without a motive.(See plan B, Fig. 41). Indeed the side arch C being wider at the base than the archivolt D carries its crown higher, which allows the opening of great windous suitable to light the choir. The triforium E, occupying a very considerable space between the crown of the archivolts of the gallery of the sedond story and the sills of the upper windows, permits placing a roof F over that gallery with a sufficient slope, in spite of the inclination of the vault G. Let us examine this section carefully. We see t that the abacus of the capital of the pier A receives by corbelling the base of the column H, which supports the rib of the vault; this little column and the two others flanking it and carrying the side arches do not unite with the construction (see plan), but are composed of large pieces of stone set on edge. It is the same with the little columns against the gallery and the engaged column I. Thus the pier at the height of the gallery is a prism composed of courses and surrounded by columns on end like the supports of carpentry, in order to secure stiffness under the loads and upper thrusts. It is the

same for these piers at the height of the triforium E (see p plan), the nucleus is set in courses and the little columns surrounding it on three sides are set on end. The larger columns at the head are connected by bands forming rings to the body of the construction, by their base and the capital K beneath the imposts. To maintain this cluster, it was necessary to have recourse to the flying buttress. In the plan of the ground story it is evident (Fig. 41), that the architect desiring to open his chapels as much as possible, had made behind the head pier only a very light partition of stone. He could not built a solid abutment on that partition; so he abutted the vaults of the gallery of the second story by a first flying buttress L (see section), transferring this thrust to the abutment separate from the wall of the gallery. But space was lacking on the exterior, and he did not wish the projection of the buttress to exceed the circular line enclosing the chapels. That abutment was then of little depth and unable to resist the thrust of the great flying buttress. Then instead of placing the springing of the great flying buttress vertically over the surface M, the constructor advanced the springing to O. Thus he obtained a strong abutment from O to P, and if he loaded the haunch of the lower flying buttress I, this was rendered very resistant, first by the extraordinary width given to it, then by the upper load R resting on its abutment. Further, to avoid the effect of the thrusts of the great vault between the junction of the great flying buttress S and the springing of the vaults T, he set the external wall of the t triforium E and column V on edge, that perfectly stiffened t that space, just like a strong wooden strut. Further, under that impost T, that forms a lintel in the triforium and is a little distant from the exterior, the architect has turned an arch G, which powerfully shores the entire upper system of t the construction,[1] and gives an even greater resistance to t the arch L. Understanding the effect of the thrusts of the v vaults of the gallery and of the flying buttress L destined to neutralize them, fearing the effect of the thrust of a too w wide vault on the internal piers at the height of the gallery of the second story, the architect advanced the pier X to overhang the lower column Y, not having to fear a vertical load at that point, but much rather an oblique force produced from

X to Z. As for the great flying buttress, its voussoirs radiate from the centre of the arch above the column V, as if it did not exist; and beneath the head voussoirs the abacus of the capital forms an angle with three voussoirs as indicated by the detail U; a simple stone a firms a wedge between the abacus and the voussoirs. There one recognizes all the acute observation and even the subtility of those primitive Gothic constructors. In the entire height of the pier from A to E could occur settlements; because of these settlements, the head S of the great flying buttress might be displaced, and exert such a pressure on the column V as to crush it, or in resisting it would produce a rupture at S′, injurious to the preservation of the arch. Placing the column as sketched at U, the sinking of the head of the flying buttress could only cause the abacus to slip slightly under the arch and incline the column V a little outwards. In that position resulting fr from the settling of the great buttress, that column V would press on the arch and load the pier X obliquely, this would cause no danger, since that pier X is placed to act obliquely; further, the column V presses strongly in the triforium wall supporting it, and consequently on the engaged column I, an important point, for this monolithic column I, independent of the pier against which it stands, being heavily loaded and u unable to settle, transfers the principal load on the pier to the external surface A′ of the circumference of the lower column, i.e., to the point at which it was necessary to obtain a greater rigidity to prevent the effects of the thrusts of the side aisle. There are calculation and foresight; for one will note that the engaged column I″ opposite to I is built in courses like the pier X; it was indeed important that this pier should not have the rigidity of the internal pier, that it could yield to settlement so as not to cause a rupture between O and L, if the great buttress settled, which could not fail to occur.

Note 1.p.79. These arches have since been destroyed and replaced by masonry and wood, when the coverings were restored in the 15 th century. It is time to think of replacing them.

So then in this structure the two systems of resistance, o preventive and opposed, explained in our two figs. 40 and 40 bis, are simultaneously employed. All that may be subtle, too

subtle, we grant; but this is not the point,forrudeeror barbaric. The constructors of that time sought without ceasing, and routine had not taken hold of them; by seeking they found, they advanced and never said;"we have arrived, let us stop here;" it seems to us a very good instruction to follow. We desire today an architecture of our time, a new architecture; that is a very good wish. But it is necessary to know how one invents a new architecture. This is apparently not by forbidding the study of the art most fertile in resources of every kind, the most flexible and free in the use of material means.

However there presented itself a very serious and entirely novel difficulty, when were required vaults of double side a aisles surrounding sanctuaries of great extent. The examples just given all belong to edifices of moderate dimensions, and we see that at S. Remy of Rheims and in the church of Notre Dame of Chalons, for example, the external wall comprises a greater number of supports than the inner one, to avoid excessive openings of arches. In a choir like that of the cathedral of Paris, surrounded by double side aisles, it was necessary to arrange the piers so as to make the openings of the transverse arches nearly equal, to obtain vaults with crowns all attaining the same level. The two outer enclosures must then comprise a greater number of piers than those of the sanctuary. At the cathedral of Paris indeed, we see (44) that the c circular part of the sanctuary, built about 1165, rests on 6 piers, while the second enclosure comprises 11 and the third 14.Thanks to that arrangement, the archivolts A B, B C, etc., the transverse arches D E, E F, etc., G N, H I, I P, etc., a are nearly placed on equal diameters, and the vaults connecting these arches, to carey the rubble compartments, are only composed of single diagonal arches B E, E C, F I, I E, E H, H H D, and no longer of groin arches. In the gallery of the second story, the same system of vaults is employed and repeats the plan of the first enclosure. Fig. X gives the form of these vaults erected on the triangular horizontal plan. The great buttresses K L M alone maintain the stability of the edifice; they receive the flying buttresse of the great upper vaults and the little flying butteesses of the gallery of the second story, turned from G to D, from P to F, etc.As for the thrusts of the two diagonals B E, C E of the vaults of the g

gallery, they are abutted by two little flying buttresses turned from I to E and from H to E. Thus the thrusts and principal loads are transferred to the great external piers K L M, and the thrusts and secondary loads to the intermediate external piers O R S.[1] In the interior, cylindrical columns in the ground story alone support that vast edifice, erected and tolerably complex in its combinations and sections. It is unnecessary to be very expert in architecture to recognize by merely casting the eyes on Fig. 44, that the evident intention of the master of the work was to occupy with his points of support the least possible space in the interior, that he at the smae time held to covering the two side aisles by vaults with crowns all at the same level, so as to be able to place on t these vaults the area of a gallery and floors having a regular inclination toward the outer perimeter. Shortly after the construction of this apse however, the constructors brought closer the piers A B C, so as to obtain around the sanctuaries narrower bays than those parallel to the axis, and they stilted the archivolts A B, B C; but we should recognize that there is an amplitude in the arrangement of the inner semicircle of Notre Dame of Paris, an independence of conception that charms us. The vaults are skilfully turned on these piers, w whose number increases in each series. It is skilfull without effort and research. Let us also state that Gothic vaults alone permitted the use of that method, and that the first architects that applied to their structures, at once knew how to derive from it all possible benefit.

Note 1.p.82. It is understood that we here speak only of t the primitive construction of the choir of Notre Dame of Paris, before the construction of the radiating chapels.

In the space of 25 years, architects at the end of the 12 th century had then obtained results, that had preoccupied t their predecessors during the entire Romanesque period, viz:- to vault wide and high edefices while retaining in the interior only slender points of support. The triumph of construction equilibrated by opposition of thrusts, and by addition of upper loads reducing these thrusts to vertical action, was t then complete; there only remained to simply perfect the means of execution. The constructors of the 13 th century did this, often with too much audacity and confidence in their

principle of equilibrium, but always with intelligence. It is evident that sagacity was the dominant quality of the apostles of the new school. Their efforts tended always to improve upon preceding work, to push the consequences of the accepted principle even to abuse; so muor so that during the 14 th century was a reaction, and constructions of questions of equilibrium solved with the most boldness are those raised during the second half of the 13 th century. We shall have occasion to return to that fact.

If it be desired to state the extreme limit reached by the architects of the end of the 12 th century, in regard to the slenderness of the points of internal support and of stability obtained by means of the equilibrium of opposed forces, it would be necessary to see the sanctuary of the church of S. Leu d'Esserent. Certain parts of this structure were erected about 1190, and are made to excite our astonishment. This sanctuary is composed in the semicircle of four single columns, two great and two small thus arranged. (45). The two culmns A are only 1.6 ft. diameter, and those at B are about 2.8 ft. A perspective of two bays of the circular plan resting on the columns A (45 bis) indicates sufficiently to us, after what we have just said, that the constructors then counted only on the equilibrium of the acting and resisting forces to maintain such a mass on such a slender point of support. One sees the column A with 1.6 ft. diameter crowned by an extremely expanded capital, (Art. Chapiteau, Fig. 21), on which rests a strong impost aud three little monolithic columns supporting the upper vaults. The impost is corbelled out to receive the pier of the triforium and the wall that closes it. The external flying buttress pushes all that construction from outside to the interior; but being erected on a circular plan, it cannot be forced in, and the more the flying buttress pushes against the head of the pier, the more bearing has the construction. The enormous load received vertically by the column H ensures its stability. The equilibrium cannot be destroyed, and in fact this chevet has suffered no movement.

Yet in Ile-de-France the constructors always knew how to r retain a certain moderation and never fell into the extravagances so common among the architects of Champagne and Burgundy. Among the latter these exaggerations were justified to a

certain point by the excellent quality of the materials of t that province, and the Burgundian architects trusting to the point of view of construction, in making us understand how far the application of the Gothic principle can go, when the material comes to its aid.

The vault was henceforth the generator of all parts of vaulted edifices; determining the place, from the arrangement of points of support, and it is first what we must scrupulously study. For whoever knows well the structure of the Gothic vault, the infinite resources presented by its construction, a all other parts of the masonry are naturally derived from that. Our readers have been able already to acquire some knowledge of the elements of the construction of vaults, it remains to examine its details, varieties and improvements, for we cannot longer make ourselves understood, unless before proceeding farther, the different means for closing Gothic vaults are not completely developed.

Figs. 27, 28, 28 bis and 29 indicate how are traced the lower beds of the imposts of the arches on the abacuses of the capitals, how these lower beds determine the forms of these abacuses and the place of the little columns and points of support. One easily recognizes, that in the first traces of Gothic vaults, the constructors avoided as much as possible causeng these arches to intersect each other at their springiugs; they cut each voussoir on the yard according to the section given for each arch, and they sought to arrange them the best they could on the abacus, by cutting them away at the back to conform their setting to the intersections. Thus for example, having traced on the abacus of the capitals intended to receive a transverse arch, two groin arches and two little columns supporting the side arches, the bed of these different members, they set the voussoirs of each of these arches and t the bases of the little columns as shown in Fig. 46, cuttiug away the tails of these arches, if necessary, as may be seen at A, so as to place them beside each other, and to include t them within their impost bed. This naive method did not require for the stonecutter any special sketch of the impost, required a bearing on the abacus sufficiently large not to weaken too much the tails of the voussoirs, and consequently capitals quite enlarged; it also had the inconvenience of produ-

producing imposts without resistance that might crush under the load, and of extending the effects of thrusts too low, or to bring their resultant near the external surface. Having to set these arches, the most natural idea was to give to each one its impost. But in certain cases, the primitive Gothic c constructors had been forced however to cause to intersect, the various arches supporting a vault on a single capital, i isolated as seen in Fig. 42, and to give them a single impost for all; for on these narrow bearingr, it was no longer possible to think of arranging the first voussoirs of these arches as one notches together the pieces of a game of patience; that would have been to make these first voussoirs a combination of wedges without resistance. Besides, it was often necersary for these first voussoirs of arches (if they had to support an upper pier) to form a pier, i.e., should present actual c courses with horizontal beds, in order to resist the pressure.

For example (46 bis), let a pier A have to support an upper pier B above a vault C. If the arches of this vault are all independent from their springings and have cut extradosses, if the joints of the first voussoirs are normal to the curves, it is clear that the pier B will not rest on the bearing E F as it should, but on the weak filling G, and that then its s stability cannot be assured, that the pressure on the haunches of the first voussoirs will infallibly cause disorder, ruptures and crushiug. Yet this method was that employed by the last Romanesque architects, and it frequently had disastrous results. In such a case the first Gothic constructors proceeded differently. Let H be the pier bearing the upper load K; they set as many imposts with horizontal beds as necessary f for the verticals L M to find a bearing, and commenced the s sections of the voussoirs normal to the curves only when these curves became free from the vertical surfaces L M. Up to a c certain height, the arches were composed then in fact of a s series of corbelled courses with horizontal bads. These constructors had too much sense to imagine the radial joints I, that could never be set well, and whose beds could not be accurately fitted with mortar; they preferred frankly to adopt the corbellings. These had also an advantage, they partly destroyed the effect of the thrusts. We must not omit to say here, that the front voussoirs or imposts are always set vertically

above the upper square of the bell of the capital, as indicated by the brace B, Fig. 47; as for the square of the base of the little column of the side arch, it is set even with the abacus, so that the shaft of the little column comes vertically over the square of the bell of the capitala (See the same Fig. 46).

When it was admitted, that one could place at the springings of vaults a series of imposts of arches, superposed with horizontal beds, architects had not need to occupy themselves in finding a bearing sufficiently large on the abacus of the capital to receive the voussoirs of several arches placed together, but only to see that these arches intersceted each other on the smallest bearing possible. Always pursuing their reasonings rigorously, they recognized equally, that the resistance of the arches in the system of vaults recently adopted is according to the height of the voussoirs and not by reason of their area, and that with equal areas of section, a voussoir, for example,(47), set as indicated at A, resisted pressure m much better, than a voussoir set according to sketch B. Now a about the beginning of the second half of the 12 th century, the voussoirs of arches are generally comprosed in a square s section C of 3.7 to 13.0 or 19.7 ins, according to the span of the vault; while toward the end of that century, if these voussoirs of transverse arches still retained that section, those of the diagonal arches (whose diameter is greater, but which do not have to resist the prersure of the flying buttress) lose a part of their width and retain depth, as seen at D. Taking less breadth from E to F, their trace on the impost of the capital occupies less space, requires considerable less enlargement, aud accommodates itself better to the intersections; having only the blunt edge at G or a simple round, the skew springing on the abacus no longer presents the awkward a and inconvenient surfaces, produced by arches of section C. Gradually the architects even renounced that section C for tr transverse arches, and adopted sections analogous to H, likewise offering from I to K a great resistance in depth, and fr from L to M a resistance sufficient horizontally to avoid torsion, already maintained by the compartments of the vaults. Thus each day, or rather after each experiment, the architects came to suppress in the construction of vaults everything not

absolutely indispensable to their stability, that they abandoned the last Romanesque traditions in order to obtain:- 1, greater lightness, 2, facility in setting the imposts, since t their imposts must thereafter determine the construction of the piers, and consequently of all lower members of the edifices.

But we are obliged, at the risk of seeming lengthy in our explanations of the system of Gothic vaults, to proceed like the constructors of that time, and to follow without leaving it f for an instant, the course of their progress. Since these constructors had adopted the flying buttress, i.e., a resistance opposed at certain points to the thrusts of the vaults, it w was indeed necessary to collect these thrusts; and to cause that their resultant should only act just at these isolated points; then it was of the last importance, that these transverse and the diagonal arches should so intersect:- 1, so that the resultant of their thrusts is converted into a single pressure at the point where abuts the head of the flying buttress; 2, that no part of the thrust could act outside or beside that resultant; in brief, that the group of thrusts should be perfectly directed in a single and the same line of pressure at the time of meeting the flying buttress as an obstacle. Va Vaults with imposts placed according to Fig. 46 could not attain this absolute result; their thrusts must be, indeed are diffused, and do not combine exactly in one resultant, whose direction and force can be exactly estimated. But if instead of these first voussoirs set well or badly beside each other on the abacus of the capitals, occupying a large bearing and without connection together, we assume an impost forming a s single course; if we combine the springings of the arches so that they completely intersect, so as to make one impost instead of three, we shall have already made an advance, for the resultant of the different pressures will be produced on a s single block of stone, which it must render immovable; but if again no being satisfied with that first result, having grouped our arch springings in as small an area as possible, we regard the imposts as only corbelled courses, that we place several of these courses or impost blocks on each other by c cutting their beds horizontal until the development of the cu curves of each arch allows us to separate their voussoirs from this loaded mass, then we shall be certain to have at the

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base of our vaults a resultant of the pressures acting in a line, of which we cannot exactly estimate the starting point, fore and direction; further, we shall be certain that the head of the flying buttress will rest, not against masonry without connection and strength, but against a rigid structure p personifying a homogeneous surface, just as would be the carpentry against which rests the head of a shore. But we have made progress; first we have recognized that vaults with diagonal arches comprising two bays, i.e., on a square plan whose diagonals are cut by an intermediate transverse arch, compel us to give the vaults a very swelled form, which obstructs us in placing the carpentry; for the diagonals of the square being much longer than are one of its sides, these diagonals serving as diameters of the diagonal arches elevate their crowns above the springings to a height equal to this half diameter (Figs. 20, 20 bis, 21), a height that the crowns of our transverse arches cannot attain, unless by making these arches sharply pointed.

About 1230 men then renounced this mode of vaulting on a s square plan, and established the diagonal arches of the high nave on a rectangular plan, i.e., each bay has its complete vault. We can then cause the crowns of the diagonal, transverse and side arches, to attain the same level or nearly so. The constructors, desiring to have springings with horizontal beds up to the point at which these arches cease to intersect, observed that the simplest methods so that these springings may cause no difficulties in drawing, consists in giving to the diagonal and transverse arches the same radius. Then let a vault be on a rectangular plan (48), the diagonal arch A C revolved in the round arch A B C; transferring the radius A D to the base line of the transverse arch A E, we obtain at F the centre of one branch of the transverse arch, and we draw the arch A G, that has the same radius as the arch A B C; transferring the distance A F from E to F′, we obtain at F′ the second centre of the transverse arch, and trace the second b branch E G. Thus were traced the arches of the first Gothic vaults on a rectangular plan.[1] Then the curves of the diagonal and transverse arches being the same, their sections are alike, and their imposts present no difficulties in drawing. Let us now see how to trace the imposts. Let (48 bis) A B be

the directrix of the transverse arch, A C the directrix of the diagonal arches. A is placed on the face of the wall. From t this point A, taking on the line A B a length A D = to the d depth of the transverse arch, and regarding A D as radius, we draw the semicircle D′D D″. We then tr.ce the section of the transverse arch on the horizontal plane. We draw two parallels E F to the directrices A C of the diagonal arches, leaving b between these parallels a distance = the width if the voussoirs of the diagonal arches. These are the horizontal projections of the diagonal arches. Taking the point G of the intersection of the axial lines of the diagonal arches with the semicircle D′D D″ as the intrados of the diagonal arches, we trace the section of these diagonal arches on the horizontal p plane. We then have the bed of the first impost. In the spaces remaining between the semicircle D′D D″ and the diagonal arches at H, we place the little columns intended to support the side arches. The outline of the lower bed of the first i impost being obtained, we can (only then) trace the abacus of the capital, either returning it square as indicated by I K L or in star form as indicated by I′K′L′. Beneath these abacuses one can place only one capital and one column M, since our intention is to combine the arches as much as possible in a small group. This capital is a corbel, a corbelled stone relieved by the isolated column, causing three corbels to project from a single astragal. It is necessary for us to revolve about the line N O the transverse arch, and about the line A C the diagonal arch. It is clear that these two arches cease to intersect at the point P on the horizontal plane. From the p point P erecting a perpendicular P P′ to the line N O, the b base of the transverse arch, and a second perpendicular P P″ to the line A C, base of the diagonal arch, this first perpendicular P P′ will cut the extrados of the revolved transverse arch at the point Q. This point Q then indicates the height at which the transverse arch separates from the diagonal arch; it is the level of the bed of the last springing block. It is necessary to divide the height P Q into a certain number of courses according to the height of the layers. Assuming that three courses suffice, the upper bed of the first impost block will be at R, the second at S and the third at T. At Q the arch separates, and we can trace the first section Q V directed to

the centre of the arch. From this point the voussoirs with s section traced at U are independent. Et will suffice to proceed in the same manner for the diagonal arch in tracind the beds R'S'T', above the base line A C, distances between these being same as for the beds R S T. The diagonal arch bening l less deep than the transverse arch, there will remain behind its extrados at Q', until the intersection with the extrados of the transverse arch, a small surface of the horizontal bed, that will be very useful to us for beginning to set the rubble filling the compartments of the vaults. This done, we can then give the stonecutter each bed of these springings referred to the horizontal plane, as we have traced at in X, the sections that we give in the arches revolved, the beds R S T, R'S'T'. Then we obtain:- 1, at a the lower bed of the first impost block, already traced as stub of the arches; 2, at b the upper bed of the first impost block, that forms the lower bed of the second; 3, at c the lower bed of the third impost block; 4, at e the upper bed of this third impost block, with its i inclined sections marked at d. It is unnecessary to state that those impost blocks, if not all, at least the two first, tails in the wall, whose face is Y Z. Would you place the diagonal arches still closer to the transverse arch? It would suffice in beginning the operation to draw on the horizontal plane t the axial linesof the diagonal arches from the point A. Even frequently these axial lines do intersect at the point A. To not uselessly complicate the Fig., we have assumed the arches to be merely blocked out; if they have mouldings, one would not proceed differently on the sketch, but in tracing the profiles, for it is necessary to know on the different horizontal beds of the impost blocks, the oblique cuts made on those profiles, so as to give the stonecutter outlines, that take i into account the more or less sensible deformation of the mouldings at each bed.

Note 1.p.90. One will indeed note, that these first vaults are quite flat, compared with those of the middle of the 13 th century, and that their transverse arches approach the semicircle. Later these vaults appeared insufficiently stable; the diagonal arches were made more acute, or indeed their springings were stilted, so as to be able to raise the crowns of these transverse arches.

To make intelligible the operation just traced, even to persons not familiar with descriptive geometry, we assume (48 ter) the three springing blocks of the preceding Fig., viewed one over the other and moulded in perspective. At A is seen the f first springing block, at B the second, at C the third with its cuts normal to the courses of the arches, at D the voussoirs of the transverse arch, at D′ those of the diagonal arches free from the springing blocks, theiefore similar as far as to the key.

Still it occurs that the arches of a vault are of very unequal dimeters, or that their imposts are at differeut heights; that can nowise disturb the stonecutter; from the moment that one of the arches separates from the others at the extrados, it has a section normal to its curve and the voussoirs are so set, while beside it other arches may remain engaged up to a certain height, and retain the horizontal beds of the impost blocks. Thus for example, (49) assuming that we have to vault a hall divided by a row of columns, whose plan at one end gives us between pier A and pier B a space much wider than that remaining between pier Band the wall C D. Hence we shall have cross vaults as indicated in our Fig. We revolve down the transverse arch E F, which gives us the pointed arch E G F; we revolve the diagonal arch F I, which gives the slightly pointed arch F H I; also the diagonal arch K L, which gives the s semicircle K M L; the transverse arch P N, tracing this arch so that the crown may be a little below the level of hre crown of the diagonal arch K L, and that its curve approaches a round arch, to lead the eye without abrupt changes to the level from the great vaults comprised betweey A and B.to the n narrower and lower vaults comprised between pier B and wall C D. It is then useful to raise the springing of this transverse arch P N. It is revolved in P O N. It is the need of avoiding abrupt changes of level in these different arches, which has caused us to slightly raise the crown of the diagonal arch F I above the round arch. Thus one sees from the g great transverse arch between piers A and B to the little t transverse arch between pier B and the wall, that the crowns R M O H and G of the arches, either transverse or diagonal, are successively lowered by a transition almost insensible to the eye in execution.

It [illegible]

It is now necessary to assume the imposts of these different arches on the capital of pier B; we present (49 bis) the forms of these imposts. At A is the springing of the transverse arch marked E F in the preceding Fig.; at B is the second springing with the two sections of the diagonal arches E I; at C is the third springing, whose upper bed is entirely horizontal; at D is the fourth springing with the sections of the two transverse arches P N, the two diagonal arches K L, and the transverse arch connecting piers A and B. One will note the projections R left on the crowns of the springing blocks behind the free voussoirs, to receive the rubble compartments of the vaults. Then there are; the first springing block bearing the section of an arch; the second with sections of two arches; the third with upper horizontal without sections. the fourth bearing section of five arches.

These methods allow great freedom to constructors, and there is no area, however irregular it may be, that cannot be c covered without difficulty. Much more, the system of vaults with diagonal arches permits the vaulting of halls, for example, with windows at very different heights, and of making very r rampant vaults. For example, assume a hall (49 ter) whose perimeter has four sides A B C D. It is necessary to have on the side A B a window 32.8 ft. high, and not raise the crowns of the side arches on the sides B C and A D more than 19./ ft., and the crown of the side arch at the side C D more than 13.1 ft.; the side C D being 26.3 ft. long; on that side C D we d draw a round side arch with springing placed on the floor itself, on the other sides we draw side arches at our pleasure, either pointed or round. Dividing the four lines A B, B C, A D, D C, each into two equal parts, we join the middle points G H, I K, by two lines whose intersection at F gives the horizontal projection of the crown of the diagonal arches. Erecting a v vertical F E, we take on this line the height to which should rise the crown L, then we have the circular arcs A L, B L, C L, D L, which are the diagonal arches, whose horizont.l projections are A F, B F, C F, D F. On the skeleton of the side and diagonal arches, there is nothing more to do than to build t the compartments of the vaults, whose intersections or crowns are represented by the dotted lines M N, O P, Q R, S T, taking into account the depth of the voussoirs of the side and diago-

diagonal arches, and the central key being assumed to be plac-ed. But we shall at once occupy ourselves with these compartments and the manner of setting them. Whatever the form of p plan of the surface to be covered, the problem to be solved is always this:- 1, to proceed to divide this area by diagonal arches, so as to present a series of triangles, for with this system of vaults only triangles can be covered; 2, to a arrange the diagonal or groin arches so that these arches abut each other at their crowns, and that one or more of those connected cannot press on the others so as to deform them.

Thus to cover a polygonal hall with 5, 6, 7, 8, 10 or 12 s sides, or even more, it naturally suffices to connect the angles of the polygon by lines meeting at the centre, as indicated in Fig. 50. These lines are the horizontal projections of the diagonal arches, and the sides of the polygons are the h horizontal projections of the side arches, which may have their crowns above or below the level of the central crown, as requirements indicate. If it is necessary to cover a portion of the polygon at the extremity of a parallellogram, or as th that is found in the sanctuaries of churches, for example (51), we arrange to have before the part B C a bay A B equal to one of the sides of the polygon B C, so that the crown D may be equidistant from the points B C E, etc., and that the triangles B C D, C E D, may have their sides B D, C D, E D equal, each to each. In this case, the arches A D abut the arches B D, C D, E D, etc., and we always only have to fill the triangles. Yet there are exceptions to this rule, and one sees the radiating arches of apses abut their heads against the crown of a transverse arch (51 bis), when for example the apse is half a polygon of 10 sides; but that method is vicious, because t the arches all pushing against the crown D and not abutted, may bend the transverse arch G H. In that case, experienced c constructors have turned two half diagonal arches I D′, R D′, intended to strongly abut the crown D′. But if these vaults may be constructed by means of arches with crowns at different levels, they can also be closed on arches of very different diameters, and whose crowns all lie on one level. It is sometimes necessary to level the crowns, if for example, this concerns vaults supporting a surface above them. This fact frequently presents itself in porches surmounted by galleries or

halls in the second story.

The porch of church Notre Dame of Dijon is one of the best examples that we can select. Its plan (52) continues the plan of the trhee aisles of the church itself; but the central vault, instead of being raised as in the church, has its crowns at the level of the vaults of the side aisles, for it is necessary in the second story to receive a level passage over t the entire area of this porch; desiring to give a base to the facade, the constructor has doubled the piers at this point and has turned parallel transverse arches, separated by a tunnel half vault between A and B, E and G, B'and C, G'and H, E' and F. Then the central part of the porch is covered by a vault with cross arches G K, E I, intersected by a transverse arch L M. The side aisles are covered by cross vaults on a square plan. On our plan we have drawn these revolved arches, whose crowns are placed in the same horizontal plane. The diameters of these arches having very different lengths, it was not possible to have these arches spring from capitals set at the same levela Thus the capitals of the diagonal arches G K, E I, and of the transverse arches E G, L M, 9 K, are placed lower than those of the arches G M, M I, E L, L K, and of the diagonal arches of the side aisles. If then we give a perspective of the pier M,(53), we shall see that the transverse arch A springs much below the other arches, and that its capital A conforms by the place it occupies, to that difference of levels. The drams of the pier support the two impost blocks C, D of the transverse arch M L (of the plan), which separates below the capitals of the other arches. As for those other arches, their imposts rest on a group of capitals relieved by little monolithic columns. The effect of the unequal thrusts of these arches acting at different heights is neutrilized by t the vertical loads supported by the piers, which are considerable.

Already about the middle of the 13 th century in England, men arrived at combinations of arches, very sagacious and perfected. The Normans quickly became skilful constructors, and in their edifices of the Romanesque epoch, they had made remarkable efforts by indicating great independence and an exceptional perfection of execution. Already at the beginning of the 12 th century, they built cross vaults with projecting r

ribs, when in France were only found Roman cross vaults without diagonal arches, but with surfaces curved in all senses, as we have seen above. They knew the benefit to be derived f from the imposts, and they divided their capitals, if not the vertical supports, into as many members as there were arches to be received. Thus in the Romanesque portion of the cathedral of Peterborough, the vaults of the side aisles of the choir opening on the transepts are for that epoch, conceived and erected with more knowledge and precision than those of the royal domain of France, Champagne, Burgundy and the Centre. T These vaults rest alternately on cylindrical and prismatic p piers set at the angles on the axes. The capitals pass from the section of the piers to the lower beds of the different arches by means of corbellings skilfully combined. Fig. 54 p presents the horizontal section A B C D E F G H of a pier, t the plan I K L M N O P of the abacus of the capital, the trace of the lower bed on this abacus, of the transverse arch Q, of the archivolts supporting the walls of the transept R, of the diagonal arches S, and of the base of the engaged column T.rising to the upper carpentry covering the principal nave. So that the crowns of the diagonal arches of the vaults of t the side aisles may not exceed the level of the extradoses of the archivolts and of the round transverse arches, these diagonal arches are traced as a portion of a circle less than a semicircle. Fig. 54 bis shows in perspective this capital and the springings of the arches; at A is seen one branch of the diagonal arch. The geometrical drawing (54 ter) explains the springing of that branch of the diagonal arch A, the imposts of all these arches and the corbellings of the capital.

When one compares this construction with those contemporaneous in France properly so-called, he has reason to be astonished by the knowledge and experience of the Norman architects, who already at the beginning of the 12 th century were able to construct cross vaults, and to divide the capitals into as many members as the number of arches to be received. But before following the rapid progress of the Anglo-norman vault, and discovering the sengular results attained by the architects beyond the English channel about the middle of the 13 th century, it is necessary for us to first examine the means e employed by French constructors for closing the triangles of

Gothic vaults. The general principle must precede varieties of execution.

Let (55) be the plan of a cross vault crossed by a transverse arch, according to the method of the first Gothic constructors. A B is the diameter of the principal transverse arch; A G the half diameter of the diagonal arch; A D the side arch; D C the half diameter of the transverse arch dividing in two equal parts the triangle A E C. The side arch must first dominate. Assume the rubble to be easily handled, so that one mason can easily set it by hand, having the width X X′ (which varies from 3.2 to 5.9 ins. in this kind of construction). We revolve the extradoses of all these arches into the horizontal plane. These revolved figures give us for the side arch the pointed curve A F D, including its stilted springing; for the principal transverse arch the pointed curve E G, for the diagonal arch the exact quadrant curve A I, for the transverse arch of the intersection tre pointed curve D H. Do not forget that the diagonal arch being round, the intersecting transverse arch must have a rise equal to C H and equal to the radius C I; that in ordinary cases the principal transverse arch must have a rise J G shorter than the radius C I, and that the side arch must have, including its stilted springing a rise K F less than that of the principal transverse arch. The width of the bed joints of the rubble of the filling being X X′, we find how many times the extrados of the half side arch A F contains X X′, including its stilting; let this then be four times; we mark the division points L M N. We have 4 courses of rubble.[1] Replacing the side arch over its horizontal projection A D, the point N on the vertical part of the side arch will fall at N′, the point M at M′, L at L′, and the point F of the crown at K. We then divide the half A I of the extrados into 4 parts, and mark the points O P Q. Replacing this curve over its horizontal projection A C, we obtain on this arch the points O′P′Q′C′. We proceed in the same manner for the intersecting transverse arch D C, whose revolved extrados is D H. We divide this extrados into 4 parts, and mark the points R S T. Revolving the arch on its half diameter D C, we obtain in horizontal projection the points R′S′T′C′. Then joining the point N′ with the point O′, M′ with P′, L′ with Q′, K with C, etc., by straight lines, these straight lines give

the horizontal projections of the vertical planes in which m must pass the sections of the intrados of the beds of the filling. These obtained, the principal transverse arch determines the number of beds of the vaults closing the triangles E E C J. The unit division X X′ giving us 6 divisions of courses on the extrados of the principal transverse arch revolved in E G, we mark the points U V Z ect., and operating as before, we obtain on the line of horizontal projection E J of this transverse arch the points U′V′Z′. Dividing likewise the extrados of the diagonal arch into 6 parts, and projecting these divisions on the line E C of the plan, we obtain the points Y Y″Y″, etc. We then connect the point U′ with Y, Y′ and Y′, etc., and we have the horizontal projection of the vertical planes in which must pass the sections of the intrados of the beds of the filling. This drawing is not made on the yard. After having divided the extrados of the side arches and of the principal transverse arches, which determine, according to the number of beds given by the width of the rubble, one divides in equal numbers the extrados of the diagonal arches as we have just shown, and proceeds at once to the construction of the vaults without centering; this is the method employed, which gives in horizontal projection the lines N′O′M′, P′L′Q′, etc., U′Y, V′Y, etc., that we have just traced on our drawing.

Note 1.p.103. To not complicate the Fig., we assume a very small number of divisions of beds. The operation is the same, whatever the division of the beds.

Here is what composes that method. For example, the constructor says that the line C K connecting the crown of the diagonal arches with the crown of the side arches shall have a r rise of 1.64 ft.; the mason is accustomed to build this sort of vaults, and has no need to know more to construct without a drawing the entirel filling triangle A C D. It suffices him to take the length C K or C J, to lay it off as C′K′ on a plank (56), to erect at the middle of that line a perpendicular a b of 1.64 ft., and to trace an arc through the three points C′b k′. With this curve beside him, he builds at least a third of each side of the filling like a wall. It suffices for him to take with a string the length of each curve of rubble, to lay off this length on the arc C′b K′, and to see that this

cord gives the rise for that portion of the arc thus cut off; this rise is what he must take for the course of the rubble for closing. The first third of the filling so nearly approaches a vertical plane, that the rubble retains itself on the b beds, as the mason sets it, as shown in Fig. 57. But beyond or about at the first third, is required the aid of a centre, a and the more because the curves of the rubble increase in length as one approaches the crown. Now sence these curves elongate, it is necessary to cu a centre for each one, which would be lengthy and expensive. It is them necessary to have t two centres arranged as indicated in Fig. 58, when together being longer than the course at crown of the filling, one of them not longer than the curve of rubble too much inclined to be turned without the aid of a support. Each of these curves being cut from a pank of about 1.6 ins. thick, has at the middle an open slot concentric with the curve given by the standard arc mentioned above.(56). By the aid of two pins C passing through these slots, the centre may be made rigid, and at each course it may be extended as needed, by sliding one part on the other. The centre is fixed on the extradoses of the arches by means of two iron angles nailed on the ends of the c centres; the mason must take care before placing the points A B on the points marked on the arches, to allow the face of the centre to hang vertically before fixing against the sides of the arches by wedges or a handful of plaster. Thus the workman closes the fillings of the vaults according to the drawing traced in Fig. 55; i.e., by giving each course of the filling a curve sufficient to hold them together and to transfer their weight to the arches, and he is no less obliged to pass this curve in a vertical plane, for he must place the centre under each line separating the courses of rubble, as shown by Fig. 59, and not beneath the middle of these courses of rubble. It is not without reason that he must place the centre in a vertical plane, and consequently keep the bed of each course of rubble in this vertical plane. These beds (60) at the intrados tracing curves, it results that the section C D must h have a greater development than the section D B, that determines the number of rows od rubble, and even that of section D A, although in horizontal projection the line D A must be longer than the line D C. The mason must take into account

at each course of rubble, this surplus width, and give to each of these courses an inner surface presenting the surface traced at E. It is then necessary for the workman to be guided by a mechanical means; the centre being always set vertically necessarily establishes the form to be given to the lower surface. If the mason closed the fillings by courses of v voussoirs with innner surfaces of uniform wildt for their entire extent, on arriving at the crown he would take into account the entire surplus of the width given by the section C D over the section D B, and he would have the two last courses of rubble presenting on the intrados a surface like that shown at G, which would be disagreeable in effect, and would compel the use at that point of rubble of much greater width than e elsewhere. By the vertical position of the centre being compelled to cause the edge of the intrados to lie in a vertical plane, without knowing it, the mason succeeds in giving each course the surplus width imposed by the concavity of the vault. All that is much more simple to execute than to explain, and we have never found any difficulty in causing this method to be adopted in parctice. A skilful mason, aided by a boy w who brings him the split rubble and his mortar, closes the t triaugle of the vault without the aid of any machine, without centering and without tools other than his axe and his centre. Once that the workmen understand the constuction of these vaults (which does not take long), he sets the courses of rubble with great facility, having only to dress them slightly with his axe to remove their parallelism. Nearly always when he h has acquired the practice, he abandons the slotted centre and contents himself with two curves held together by two spikes, extending them at each course, for the beds of the rubble being very little inclined, except near the crown, a weak support suffices to prevent it from sliding on the mortar. Each course set forming an arch, the centre is removed without the result of the least movement. It must be stated that this rubble is generally thin, and that many fillings of great Gothic vaults, particularly at the end of the 12 th century are no more than 4.0 to 4.8 ins. thick.[1] This method of constructing vaults is not the only one; it belongs solely to Ile-de-France, Beauvoisois, and Champagne during the second half of the 12 th century; while in the other provinces less reasonable means

were adopted. In Burgundy, thanks to certain particular qualities of the limestone, splitting into thin layers, rough and adherent to the mortar, men long constructed vaults of plastered masonry on wooden centerings. The vaults of the choir of the abbey church of Vezelay, built about the end of the 12 th century, present a singular mixture of methods adopted by the constructors of Ile-de-France and of Burgundian traditions. One sees how the Burgundian stonecutters, such skilful draftsmen, were embarrassed in giving to the filling courses proper forms; not being able to make the exact drawing, they experimented, built the haunches of materials cut good or bad; then not knowing how to close these fillings, they completed them by rough rubble plastered. That was not a method, but was an expedient.

Note 1.p.108. The fillings of the great vaults of the cathedral of Paris are not over 4.0 ins. thick.

In the midst of the provinces of ancient Aquitaine, the custom that the constructors of the 10 th and 11 th centuries h had contracted of closing their vaults by domes was so deeply rooted, that they onln very late understood the Gothic cross vault, and which they adopted in appearance, but not the actual structure.

Everyone knows that the voussoirs composing a dome give in horizontal projection a series of concentric circles, as indicated in Fig. 61. A being the section and B the quarter of t the horizontal projection of a hemispherical dome. When the system of Gothic construction prevailed in the royal domain, and the architects recognized the use that could be made of it, they soon desired to adopt it in all the western provinces of the continent. But these different provinces, attracted by the frank charm of the facilities presented by the new architecture for conquering obstacles before insurmountable, no however could not abruptly set aside traditions strongly rooted among workmen; there resulted from this a sort of compromise between the structure and the form. In the 12 th century were seen to rise along the entire line extending from Perigord to the Loire to Angers and beyond, vaults that by construction are actual domes, but which seek the appearance of cross vaults. These are domes beneath which have been turned two diagonal arches, rather a concession to the taste of the time than

as a requirement of stability; for in fact these diagonal arches are generally very weak and support nothing, frequently being engaged in the filling and supported by it. This observation is of major importance; we shall see at once what the consequences were. Still these builders of domes at any cost were not long without recognizing that the structure of their vaults was not at all in harmony with their apparent form. The movement was impressed over nearly the entire area of present France about the end of the 12 th century; it was necessary to adopt the mode of construction invented by the artists of the North; it was essential to abandon Romanesque traditions; they were exhausted; the people rejected them because no longer sufficing for their needs, and especially because they were the living expression of that monastic power against which rose the national spirit. The schools subjected to the d dome made a first concession to the new mode of construction; they understood that the diagonal arches were made in Gothic construction to support the fillings; then instead of setting the courses of rubble for filling as they had done at first, without taking into account the diagonal arches as indicated in Fig. 72, they took the extradoses of these arches as points of support, and turned courses of rubble, not as side or transverse arches on these diagonal arches, like the constructors of Ile-de-Drance, but as arches diagonal to the side and transverse arches, having them intersect at the crown.

Fig. 63 [1] will illustrate this arrangement. This construction was less natural than that of the vault of the North, but it gave the same sections; i.e., that from A, the crown of t the side or transverse arches, to B, the triangles of the filling A B C form a reentrant angle, a concave line. But since these junctions A B of the courses of rubble produce a bad e effect, and present a difficulty for the mason, who needed on that line A B a wooden curve to support each course of rubble as he set them; a stone rib B F was turned to receive the ends of the courses of rubble and to conceal the joints.

Note 1.p.110. Vaults of the cloister of Fontfroide near Norbonne, side aisles of cathedral of Ely, cloister of Westminster (England), side aisles of church of Eu.

At the end of the 12 th century Aquitaine was Anglo-Norman, as well as Maine and Anjou. This system of vaults not only p

prevailed in these provincesbut passed the Channel and was ad adopted in England. Gradually during the first years of the #3 th century it was abandoned in the provinces of the continent, to definitely adopt the mode of Ile-de-France; but in England it persisted and extended, was perfected and sonn led the constructors into the system of vaults opposed in principle to the French system. The manner of Setting the courses of rubble in the fillings of vaults on arches, borrowed in Ile-de-France from Roman cross vaults, in England from the d dome, had singular consequences. In France the surfaces of th the fillings always remained concave, while in England they ended by being convex at the intrados, or rather by forming a series of curvilinear cones, reversed the intersecting, producing forms consequently opposed to their origin. But when one studies Gothic architecture, he soon recognizes that reasoning, the logical consequences of an accepted principle, a are followed with inflexible rigor, even to produce results apparently very strange, exaggerated, distant from the starting point. For him that never loses the traces of the incessant attempts of constructors, the transitions are not only perceptible, but are deduced by reasoning; the slope is irresistible, they seem the result of caprice, if one ceases for an instant to hold the thread. Thus one should not accuse the bad faith of those, who not being constructors, judge what t they see without understanding the origins and the sense; what one can reproach them with is the wish to impose their judgment, and to blame the artists of our time, who believe that they find in this long travail of human genius resources and useful instruction. Each one can express his feeling, when it concerns a work of art, saying; "This pleases me, or that displeases me;"but it is not permitted to anyone to judge the p product of reason otherwise than by reasoning. It is free for each one to not admit, that a perpendicular to a straight line forms two right angles; but to wish to prevent us from proving it, and especially to recognize it, is to push the love of obscurity rather far. Gothic architecture may displease by its forms; but if one claims it is only the product of chance and ignorance, we shall demand permission to prove the contrary, and having proved it, to study and use it, if this seems good to us.

Then having to close this section on vaults, let us see how the Anglo-Normans transformed the dome of the West into a vault of a form very different in appearance from the hemispherical vault. We have just stated how the constructors of Aquitaine, Anjou, waine and England, had beem led to add other r ribs to the cross vault to conceal the junctions of the rubble filling at the lines of the crowns; i.e., how they divided a square or rectangular vault into eight triangles instead of four. This point of departure has such great importance, that we ask from our readers permission to insist on it.

Assuming a cross vault, half made by Frenchmen at the beginning of the 13 th century, and half by Anglo-Normans. The French vault will give in horizontal projection (64) the drawing A; the Anglo-Norman vault the drawing B. Hence nothing is more natural than to connect the crown C of the side arch with the crown D of the diagonal arches by a projecting rib masking the junction formed by the meeting of the filling triangles of rubble E C D, F C D. These filling triangles are evidently derived from the dome vault, or rather are four pendentives that intersect in C D. The vaults of Aquitaine or primitive Anglo-Norman vaults further have the crowns of the side arches at a level lower than the crowns of the diagonal arches, and their skeleton is presented in Fig. 65. This Fig. shows well that the Anglo-Norman vault is nothing else than a hemispherical dome intersected by four pointed arches, for the diagonal arches are round. On that skeleton the courses of the fillings in rubble and turned as marked in G, while in France, on two diagonal arches and four side arches of t the same dimensions and form, the courses of rubble fillings are turned according to the drawing.H. Then although the priicipal ribs of vaults in France or in England may be identical in drawing, in France the filling is evidentln derived from the Roman cross vault, while in England it is derived from t the dome. Until then, although the principles of construction of these two vaults are very different, their appearance is the same, save the additions of ribs connecting the crowns of the side or transverse arches with those of the diagonal arches, an addition that is not an absolute rule.

While in Ile-de-Franc and the adjacent provinces at the end of the 12 th century, there were rarely built cross vaults c

crossed by transverse arches, i.e., always generated by a square plan and closed by skew filling triangles, as shown by Fig. 55, men sought in the West to obtain the same real and apparent lightness, but always retaining something of the dome.

There exists near Saumur a little church, that indicates in the most evident manner the uncertainties of the constructors of the West between the innovations of the architects of the royal domain and the traditions of Aquitaine; this is the church of Moulinerne, there the two systems are together. The first building of the edifice has a single nave next the facade, and is vaulted according to the plan (66). From A to B is a great transverse pointed arch. From A to C and B to D are two pointed diagonal arches, that are only rounds with semicircular sections. A second transverse arch E F with similar section crosses the two diagonals. From E to G and F to G are turned two other secondary diagonal arches intersecting the principal diagonals at I and K. The four triangles comprised between the points E G F are closed according to the method of Aquitaine or the Anglo-Norman, i.e., according to the principle of the dome; the four other triangles E D I, D G I, G G C K, C F K, are closed after the French system, and still t the ribs L I, M I, N K, O K, connecting the crowns of the side arches with the intersections I and K, project below the c courses of the fillings. These ribs are even decorated by figures carved in relief. As for the triangles A E R, B F R, they are closed in the French manner by skew fillings. But a half transverse arch existing from G to R, the constructor has thought to continue it as a projecting rib as far as the top of the great transverse arch A B. Then the section made on G S gives the drawing (67). If one desires to have an exact idea of the appearance of this vault, it is necessary to refer to the prespective view, that we give (68). In the royal domain,, one would be content to close the triangles of the filling (Fig. 66), E D R, D G R, G C R, C F R, by courses of rubble placed from the side arches E D, D G, etc., to the transverse and diagonal arches E R, G R, D R, absolutely as done for the triangle A E R.

As long as the vault of Aquitaine and the Anglo-Norman retained its very stilted diagonal arches, like those of the primitive French Gothic vault, the appearances of these vaults

were nearly the same; but in France from the end of the 12 th century was recognized the advantage in raising the crowns of the side and transverse arches to the level of the crowns of the diagonal arches; 1, to be able to have higher windows, 2, to allow the tiebeams of carpentry to pass above the vaults, without raising the side walls too much. It was desired to imitate thi.: improvement in the Anglo-Norman provinces. Then a difficulty presented itself; the principle of construction of the courses of rubble of the filling derived fhom the dome 1 lent itself badly to that innovation. We have just said that a rib had to be placed beneath the junction of the ends of t these courses of rubble. Now assume an Anglo-Norman vault of the section given (69); when it was constructed according to the drawing A, the rib connecting the crowns B C could offer a perfect resistance by its curvature, but if it was constructed according to the drawing D, according to the new French method, the projecting rib C E had not sufficient rise to present sufficient resistance; if the vault was great, it was to be feared, that this rib might bend at G, about the middle of its length. To avoid this danger, the Anglo-Norman constructors did not abandon for that their method of filling; they p preferred to support this weak point G by new projecting ribs, traced in H I on the horizontal projection K, and then instead of turning the arches of the filling of rubble as traced at L, then set them as traced at K. Examining the quarter O M P;I, of the vault, one recognizes that its internal surface was already near, because of the arrangement of the cause of the arrangement of the courses of rubble filling, to giving a portion of the curvilinear concave cone. Once on that path, Anglo-Norman constructors no longer thought of the French vault, t they freely developed the principle, that they had perhaps unconsciously adopted at the origin; they saw in the Gothic vault only a net of interesting arches reciprocally staying each other, and supporting the fillings only giving each of these surfaces scarcely concave. Already at the middle of the 13 th century, they erected the choir of the cathedral of Ely, whose high vaults give the horizontal projection (70) and the s section D made on C'D'. Confiding in the strength of these crossed and counter stayed arches, they did not hesitate to raise the crowns C'D'of the side arches E F above the crowns

G, so as to have very high windows, as indicated by the section C D. But the appearance of these vaults in the interior is quite different from that of the French vaults. Here is a perspective view of one springing of the vaults of the choir of the cathedral of Ely (71). It is seen that these arches or projecting ribs give a group of curves, a considerable portion of which presents a conical curvilinear concave surface, and to render this effect more striking, the constructor has taken care to combine all the arches on the abacus of the capital into a compact group, whose lower bed we indicate (74 bis) at A, and the horizontal section at the level B, at C. But if this horizontal section traces a portion of a polygon resting on the branches from D to E; from D to F, which is the side arch, it returns abruptly, for the springing of the side arch being made much higher than that of the diagonal, transverse and intermediate arches, the rubble filling G F must rise vertically in a plane passing through G F. These vaults then present up to the springing of the side arches, a group of ribs projecting from the construction, a compact mass, heavy in fact, with a certain pretense of lightuess. Desiring to retain the crowns of the side arches at the level of the crowns of the diagonal arches, as we have already stated, and being evidently restricted in their combenations by the reentrant and vertical surfaces G F, the Anglo-Norman constructors took the method of raising the springings of the transverse , diagonal and intermediate arches to the level of those of the side arches. The presence of the vertical surface F G beside the curved surfaces D E was not logical for rationalists. But placing the imposts of all arches of the vault at the same level to avoid these vertical surfaces, the English architects however pretended to place the crowns of the diagonal and transverse arches on the same horizontal line. then it war necessary for these transverse and diagonal archer to be very depressed. Then in England men came to abandon the pointed arch for transverse arches and the round arch for diagonal arches, aud to adopt curves composed of portions of ellipses while retaining only frankly pointed curves for the side arches, as indicated by Fig. 72; the crowns A B C are in the same horizontal plane. From these groups of ribs forming pyramids or inverted curvilinear cones to vaults composed of intersecting curvilinear

cones is not far; the constructors of the end of the 14 th c century in England soon arrived at that last result.(72 bis). But these vaults are no longer closed by fillings of rubble masonry on cut arches, these vaults are entirely composed of large cut stones of small thickness, requiring drawings, complicated diagrams and certain artifices, for example, such as that of transverse arches hidden in the surfaces, as we have marked them by A B C on the sketch representing the extrados of the vault.[1]

Note 1.p.122. See Memoir of Dr. Willis on the construction of vaults in the middle ages, and the translation by M. C. Daly. Vol. 4. Revue de l'architecture.

Thus by a series of deductions, further very logical, Anglo=Norman constructors passed from the dome to these singular v vaults composed of intersections of curvilinear cones, and de departed entirely from French construction. In Normandy, these vaults were never adopted; but the English influence there r remained something. In that province toward the end of the 1 15 th century were often abandoned vaults composed of courses of rubble turned over arches. They also desired to use cut s stone. The people of Normandy, Manche and Brittany voluntarily made compound vaults; either of great cut slabs decorated by mouldings inside, supported by their joints without the a aid of arches, or of stone ceilings set on arches. One sees in the church of Ferte-Bernard near Mans pretty chapels of t the 16 th century thus vaulted.[1] (73). Those areslabs sculptured in coffers inside, set on stone arcades supported by diagonal arches. This system of construction is elegant and ingenious; but one would wish to see here rectangular windows, for the pointed side arches enclosing them have no reason for existence. The system of Gothic vaults must come to that, necessarily its final expression. To close the intervals left between the arches by ceilings, and at need to multiply the arches to the point of having between them only surfaces, that could be easily filled by one or two slabs, was to arrive at the limit of the system, and this was frequently attempted with success at the beginning of the Renaissance, either in religious monuments or in civil architecture. It is even proper to render this justice to the architects of the French Renaissance, that they knew how to employ with great freedom

Gothic methods concerning the construction of vaults, and that in freeing themselves from the routine in which were held the masters of the 15 th century, they applied the new forms and resources to the art of construction of the middle ages.

Note 1.p.123. The construction of these chapels dates from 1543 to 1544.

At the beginning of the 16 th century, the architects very frequently employed the system of vaults composed of slabs s supported on ribs, which permitted them to decorate these vaults with rich sculptures, and to obtain effects previously unknown. Composing a sort of framework of stone with pendant keystones or rosettes at the intersections of the ribs, they set carved slabs between them. This system was often adopted, for example, to vault galleries, inclined ceilings of stairways with elliptical tunnel vaults (74). Each voussoir of the transverse rib A supports at both sides of the little pendant keystone a joint B to receive the longitudinal ribs; the slabs D simply rest in rebates on these ribs, as indicated in detail X; A′ is the section of one of the transverse arches, B′ one of the voussoirs of the longitudinal platbands, D′ the section of the slab. This method is simple, and such construction is good and easily executed, the slabs can be carved before setting, it presents all the elasticity that the Gothic c constructors had obtained in the combination of their vaults. But the artists of the Renaissance very quickly forgot these excellent traditions, and if they long retained those forms derived from a reasoned principle of construction, they cut this sort of vault like an ordinary tunnel vault, no longer regarding the framework as independent ribs..

During the 15 th and 16 th centuries, the English and Normans had attained in the construction of vaults the production of surprising effects by their combination and their richness. The architects of Ile-de-France, Champagne, Burgundy and of the Loire retained, even in this last time of the Gothic period, more sobriety; during the 16 th century, they even sought to reproduce the forms, if not the structure of the Roman vault.

When the character of the people is left to its own inspiration and is not falsified by a spirit of narrow system, it depicts itself with an entire freedom in works of art, and p particularly in those which are in great part the result of

easoning. The Normans have always been rather bold workmen han inventors, they have known from all time how to appropr-ate the discoveries of their neighbors, and to apply the sys-em themselves. It is unnecessary to demand from them these fforts of the imagination, those conceptions that belong to ore southern genius, but indeed ingenious and thoughtful ap-lications, a consistent and wise execution, persistence and are in the execution of details. These qualities are found n the Anglo-Norman edifices built during the 12 th and 13 th enturies. It is unnecessary to require from Anglo-Normans hat freedom of charm, variety and individuality, which we ind in our French construction. With them a method passes or good and practical, they perfect it, extend its results, ollow its progress and stop there. On the contrary with us, en always seek and perfect nothing. Anglo-Norman structures re generally executed with much more care than are ours; but o know one of them is to know all; one does not see those n ew and bold inspirations burst forth, that have tormented o ur architects of the first time of Gothic art; a true epoch f intellectual emancipation of the laborious classes of the orth of France.

MATERIAUX. Materials.

This is interesting to observe, and it may have a conseque-ce. The more youthful the people, the more the monuments th-y erect assume a character of durability; on the contrary n growing old, they content themselves with temporary struc-ures, as if they were conscious of their approaching end. It s with peoples as with isolated individuals; a young man will uild more substantially than one of seventy, for the former oes not have the feeling of his end, and he seems to believe hat everything surrounding him cannot last as long as himself. ow the middle ages are a singular mixture of youth and decr-pitude. The old antique society still retained a breath of l ife; the new life is in the cradle. The edifices constructed y the middle ages manifest these two opposed situations. In he midst of peoples permeated by young and strong sap, for xample like the Normans and Burgundians, the structures are uilt much more solidly, and asuume a more powerful character han among the dwellers on the banks of the Seine, Marne and oire, whose customs still exhibit Roman traditions in the 1

12 th century. Even the Burgundian has a considerable advantage over the Norman, in that he is endowed with an active imagination, and that his temperament is already southern. During the Romanesque period his monuments have a character of power, that one cannot find in the other French provinces, a and when the system of Gothic commenced to develop, he took p possession of it and applied it with singular energy. Perhaps he had a taste less sure than his neighbor, the inhabitant of the banks of the Seine or Marne; but he certainly had more t than him the feeling of his strength, the consciousness of h his duration, and the means of displaying these youthful qualities. It seems that the terriotory occupied by him came to his aid, for it supplied him with excellent materials, resistant, of large dimensions, lending themselves to all the boldness, that his ardent imagination could suggest to him. On the contrary in the basins of the Seine,Marne, Oise and the middle Loire, in old France, the materials furnished by the ground are thin, light and with little resistance; they must by their nature discard the idea of rashness, and comple the constructor to replace by ingenious combinations what the soil refused him. It is necessary to take into account the properties of these different materials, and of the influence exerted by t their qualities on the methods employed by the constructors; but independently of their particular qualities of materials suitable for building, we repeat that the charcater of the in inhabitants of these provinces presents great differences, t that influence the means adopted.

The transition is complete; of Romanesque construction there remains nothing more; the principle of equilibrium of forces has replaced the system of inert stability. Every edifice at the end of the 12 th century is composed of a framework rendered stable by the combination of oblique resistances or vertical loads opposed to thrusts, and of an enclosure, a covering, that clothes this skeleton. Every edifice possesses its skeleton and its membranes, it is no longer merely a framework of stone independent of the enclosure covering it. This skeleton is rigid or flexible, according to the need of the place; it yields or resists, it seems to possess life, for it obeys contrary forces, not passive but active. Already we have been able to appreciate the properties of this system in the descr-

description that we have given of the construction of the choir of the churln Notre Dame of Chalons-sur-Marne (Figs. 41, 42, 43); but the construction appears how rude and refined at the same time, mean and complicated, if we compare it to the beautiful Burgundian structures of the first half of the 12 th century. There all is clear, frank, easy to understand; of w what wise boldness! The boldness of men that are certain of n not failing, because they have foreseen everything, that they have left nothing to chance, and know the limits that good s sense forbids passing.

We have reached the period of construction in the middle a ages during which the nature of the materials employed is going to play an important part. We cannot pass over in silence observations, that must be as the introduction to the methods of building of the Gothic architects. Such a great quantity of public and private edefices were erected during the 12 th century, that one cannot be surprised to find among the constructors a profound knowledge of the materials suitable for b building and of the resources offered by their use. Men that could not acquire a very extended instruction, by lack of complete teaching by the successive observations of several centuries, are obliged to supplement that elementary poverty by the sagacity of their intelligence; not being able to depend on developments not in existence, they must make their own observations, collect and classify them, composing a theory from them. Practice alone directs them, only later are the r rules established, and it must be confessed, that however complete the theory, however numerous and good the rules may be, they never can take the place of observations based of a daily practice. At the end of the 12 th century, the constructors had moved and cut such a great quantity of stones, that they had come to know accurately their properties, and t employ t these materials in accordance with these properties, with a very rare sagacity. Then it was not as today, an easy matter to procure cut stone; the means of transportation and of quarrying being insufficient, this must be supplied on the ground; it was not possible to procure stones from distant sources; it was then by means of local resources, that the architect must build his edifices, and frequently his resources were w weak. Men do not take into account sufficiently these difficu-

difficulties, when they appreciate the architecture of that time, and they often place it to the account of the architect, regarding it as a puerile desire of erecting str ctures astonishing by their lightness, when it is in reality only extreme penury of means. Building stone in the 12 th and 13 th centuries, compared to what it is in our time, was a rare material and consequently dear; it was necessary to economize it and t to employ it so as to use the smallest possible volume in structures. There is no need to resort to written documents to recognize that fact; it suffices to examine public and private edifices with some care, and one will recognize that the constructors not only did not set one stone more than necessary, but also that they only placed in the work the qualities suited to each place, economizing very scrupulously the dearest stones, i.e., those of very great durability or of great volume. The workmanship on the contrary being relatively cheap, the architects did not commit the fault of lavishing it. Besides it is sufficiently in the order of things, that when a material is dear in itself, one seeks to emphasize its value by unusual workmanship. We recommend these observations to persons, who not without reason, now condemn the servile imitation of Gothic architecture. Here is what might be said, b but which has not yet been thought; "If in the 12 th century 35.3 cu. ft. of stone on an average cost $40, and a day's work of the stonecutter 20 ¢, it was reasonable to use only the least possible stone in an edifice, and it war natural to emphasize the value of this precious material by workmanship, t that cost so little. But today the stone averages $20 per 35.3 cu. ft., and the day's work of the stonecutter represents $1.20 or $.40, so that there are no longer the same reasons for saving stone at the expense of stability, and for giving a material costing so little, workmanship costing so dear.[1] That argument would be more conclusive against the imitators of Gothic architecture, that for example, is not the comparison of the nave of a Gothic church to an inverted hull of a vessel; for that comparison is an eulogy, rather than a criticism, just as would be the comparison of the dome of the Pantheon to a straw beehive. But leave aside comparisons, that are no reasons, as the proverb says, and let us proceed. Constructors in the middle ages did not know the saw with sand, that l

long blade of wrought iron by means of which, by a horizontal reciprocal movement, a workman can cut enormous blocks into slices as thin as the need requires. There are still 70 departments in France in which that very simple instrument is not employed, and these are generally where they build best, for one can contest the advantages of the saw with sand. France abounds in very varied beds of limestone, very good and easily quarried. These beds as all know, are hard or soft, thin or t thick, usually thin when they are hard and thick when soft. Now it is always advantageous in construction to respect the order of nature; that is what the ancients frequently observed, and is what was most scrupulously observed by the Gothic constructors. They quarried and employed the materials such as afforded by the beds of the quarries, even subjecting the architectural members to the heights of these beds. Never doubling the stone as we now see done on our yards, they set t them entire in their structures, i.e., with their heart retained iu their middle part, their lower and upper beds, contenting themselves with cleaning them.[1] This method is excellent; it preserves to the stone all its natural strength, all its means of resistance. If Gothic constructors of the first time employed soft stones for points of support (which they were often forced to do for lack of finding others), they took care to use them with a great height of bed; for in that case soft stone is less subject to crushing. As for hard stone and the thinnest among others, which are generally the strongest, they used them as bands, continuous lintels to connect together distant piers, they formed the points of support of them, which should bear a very heavy load, either by piling them on each other, if these supports were very thick, or by placing them on edge, if the supports were sleuder. With regard to s stones set on edge, one recognizes all the acuteness of observation of the constructors. They were not ignorant that stones set on end are subject to split, so they chose them with particular care in lower beds, very homogeneous and compact, in the gypsum at Paris, in the hard stones of Tonnerre,[1] in lower Burgundy and Champagne, in the thin beds of upper Burgundy, hard as sandstone and without seams.[2] Experience had taught them that certain hard stones of fine grain, like the gypsum of the little hard bed of Tonnerre, for example, composed of

thin layers of limestone, superposed and connected by a solid cement; that these stones by their texture itself, had when set on end a sort of counter grain of extraordinary strength; that they resisted enormous pressures, and that strongly held under a great load, they split less easily than if set on bed; for what causes these stones to split is the dampness that t they collect between their thin layers and that swell their marly layers; now set flat, they are more apt to retain this dampness than if set on edge. In the last case the water slips over their surfaces and does not penetrate the superposed layers. As proof of what we have advanced, we can cite a number of gutters, drips, cornices, flag stones of lias or gypsum in very old edifices, set ou bed and often found split; while the same materials in the same monuments set on edge a are perfectly preserved, only split by accidents, such as rusting of cramps or pins, or by some defect. We must not omit here an important fact in the structures of the middle ages, which is that the beds are cut with the same perfection as t the visible surfaces, and that the stones are always set in a bed of mortar, and not jointed or cast, which is worse. At most and to terminate this digression concerning materials suitable for building, we shall add that the constructors of the first Gothic period subjected their system of construction to the materials at their disposal, and consequently the forms of their architecture. A Burgundian architect in the 12 th c century did not build at Dijon as at Tonnerre; if one finds in the same province the influence of the same school, in the execution of the masonry will be noted considerable differences resulting from the nature of the stone employed. But as in each province there is a dominant qualitw of material, t the architects adopted a method of building conforming to t the nature of these materials. Burgundy, so rich in stones of superior quality, supplies us with the most evident proof of that fact.

Note 1.p.128. Perhaps some one will ask how it can be that stone was so dear while the work was so cheap, since stone o only acquires value by being quarried. To that we reply that quarrying may be done with more or less skill, and by means of machines more or less powerful; that a very advanced industrial condition always brings a reduction of price of raw ma-

materials, by facility in quarrying, transportation, and because the use of perfected machines, for example, 35.3 cu ft. of stone only $1.00 for transportation for 2 miles by canal, and would cost $4.00 or more if brought the same distance in wagons; if the roads were bad, the difference would be greater. Now that is what occurred in the middle ages, not counting the dues of the rights to quarry, that were often enormous. Centralization is one of the most certain means of obtaining raw materials cheap. Formerly there was not an abbot or lord over whose lands it was necessay to pass, who did not charge for the right of crossing, and these dues being arbitrary, t there resulted a considerable increase of the cost of quarrying. And the proof that this was so is, that we see, for example, monastic establishments frequently go to seek stone at e enormous distances, because it came from quarries belonging to them, and that they only had to follow the roads free from all dues, while they did not bring materials from very near, that required the crossing of lands belonging to owners not vassals of the abbey.

Note 1.p.129. To clean stone is to remove from its two beds the parts of the limestone that preceded or succeeded complete geological formation; in brief, to remove the parts liable to decompose by action of air or dampness.

Note 1. p. 130. Those hard beds of Tonnerre are no longer quarried, although their qualities are excellent; they are called "stones of wood".

Note 2.p.130. Stones from Manse, Dornecy, Ravieres, hard f from Coutarnoux, Anstrude, Thisy and Pouillenay.

DEVELLOPPEMENTS. (XIII SIECLE). Developements in the 13 th Century.

At Dijon exists a church of moderate size under the name of Notre Dame; it was built about 1220; it is a masterpiece of reasoning, where science of the constructor is concealed under apparent simplicity. We shall commence by giving an idea o of the construction of that edifice. The chevet is without s side aisles and opens into the crossing; it is flanked by two chapels or little apses orientated like the sanctuary and opening into the transepts in the prolongation of the side aisles of the nave.

The apse of Notre Dame of Dijon is composed internally of

only of a thick and low substructure bearing isolated piers connected in all directions, and having for external enclosure only a sort of partition of stone pierced by windows. Naturally the piers are designed to support the vaults; as for the walls, they support nothing, being merely an enclosure. On the exterior the construction consists only of buttresses. Fig. 75 gives a perspective view of that apse; being without side aisles, the buttresses directly abut the vaults without flying buttresses.[1] These buttresses are thick and solid; in them alone resides the stability of the edifice. Nothing is more simple in appearance and in fact that that construction. Thin walls pierced by windows close all spaces left between the buttresses. An external passage at A is left to facilitate the repairs of the great stained glass windows. All surfaces are well protected from rain by slopes without projections. of cornices or bands. This is evidently only a solid enclosure, a shelter. Let us now enter the church of Notre Dame of Dijon. Just as the exterior is simple, solid, covered and sheltered, so the interior presents light aud elegant arrangements. This monument was and still is built in a populous quarter, surrounded by narrow streets, the architect thought he m must sacrifice all to the internal effect. One further recognizes that he must have been limited in his expenses, to avoid useless costs. He is not lavish with materials, he has not w wished to set an unnecessary stone. Then the apse (76) is internally composed of a solid substructure A, thick and built in courses, decorated by an independent arcade as a facing. From that substructure already rise the little columns B, which ascend to the springing of the arches of the great vault. These little columns are set on end from the base of the band C, which connects them by a ring with the external construction. On that substructure is a passage or service gallery designed to facilitate the maintenance of the stained glass windows D and to hang the church if necessary on festal days. T The piers E are isolated; they are composed of four columns set on end frsm base to capital, one large (14.6 ins. diameter) and three small ones (4.7 and 5.9 ins. diameter). At A′ we give the section of these piers. The great column and the two side columns are each of a single piece as far as the course F of the capitals, while the little column rising from the

pavement is of a single piece up to the slab G. This slab G forms the ceiling over the low gallery and connects the great arcade with the external surface. In the height of the gallery of the third story (triforium) is the same arrangement of the piers, the same section A'; only that an intermediate little column H supports an arcade likewise composed of great p pieces of thin stones, like slabs set on edge. Above the triforium a second series of slabs I serves as ceiling of that triforium and connects the arcade to the external construction; then spring the arches of the great vault abutted by the external buttresses. The high windows then open over the arcade of the triforium, and are no longer recessed below, in order to give all light possible, and to leave on the exterior the passage mentioned above. Thus the thrust of the arches is transferred obliquely to the external buttresses, which are built in courses, and the internal piers are only rigid points of support, incompressible, since they are composed of great stones set on edge, but which by their small bearing only present a shell able at need to incline from one side or the other, outward or inward, without danger, even if a settlement remains. As for the walls K, as we have already stated, they are merely partitions at most 4.0 ins thick. Let us now remove from this structure all that is merely accessory to take its skeleton, when we shall find (77); A is a built buttress, a passive mass; B is a slender support though rigid, resistant like cast iron, due to the quality of the limestone employed; C is a course above the arches, consequently flexibility at need; D a connection of the interior and exterior; E a second support, but shorter than the lower one, for the monument rises and the movements produced will be more serious; F a s second course joining the interior and exterior; G are imposts; H are simble enclosures with nothing to support and only serving to enclose the edefice; I the abutment only where acts t the thrust of the arch. Nothing too much but all that is necessary, since this construction has maintained itself more t than six centuries, and does not appear near to its ruin. It is necessary to recall here what we have said concerniug the function of the monolithic little columns, which accompany the columns B and E, and that we have assumed to be removed in F Fig. 77; they are only the accessory supports that give firm-

firmness and bearing of the principal columns, without being absolutely indispensable. The load of the vaults rests very safely on the buttresses, because of the action of the thrust on the cylinders B E (Fig. 23). The internal group of little columns supporting only a very small load, there was no need to give them great strength. But if we have a side aisle, if the buttresses, instead of being directly opposed to the action of the vaults, be removed from them by the entire width of the side aisle, then the vertical piers must have more bearing, for they really carry the weight of the vaults.

Note 1.p.131. We may indeed be permitted an observation on this subject; in appreciating more or less the merit of Gothic religious edifices, some critics (who are not architects, it is true) have claimed, that of the churches of the middle ages in France the most perfect, that which indicates on the part of the architect the greatest talent, is the S. Chapelle of Paris, for that retains a perfect stability without the aid of flying buttresses; and starting from that, the same critics, doubtless happy in having made that discovery, have added; "The flying buttress, a permanent stone shore marks the lack of p power of the constructors, is only a barbaric superfluity, a useless sport, since during the middle ages skilful artisans have known how to do without it." The argument is strong; but the S. Chapelle has no side aisles; hence the architect was not compelled to cross that space and transfer the thrusts of the great vaults to the exterior outside the side aisles. However it is, others that one always speaks of an art unknown to him; and the multitude applaud him, for practicians do not believe it necessary to refute such arguments. They are wrong; an error repeated a hundred times, were it one of the most g gross, but repeated with assurance, ends with us in being accepted among the least contestable truths; and we still see printed today with the best faith in the world, on the arts and especially on Gothic architecture, arguments refuted long ago by the criticism of the facts, by history, by the monuments and by demonstrations based on geometry. All this labor for truth, that desires to appear to pass unperceived by the eyes of certain critics, who probably claim to forget nothing and to learn nothing.

The nave of the same church of Notre Dame of Dijon is vaul-

vaulted according to the primitive Gothic method. The diagonal arches are on a square plan anf are intersected by a transverse arch. The lower piers are cylindrical, built in drums and of equal dimeters. However the capitals differ in pairs, for they alternately support either a transverse arch and two diagonal arches, or only a transverse arch. Here (78) is a view of the internal bay of the nave of Notre Dame of Dijon. At A′ we have traced the section of the impost A′,at B the s section of the impost B, with the horizontal projection of the abacuses of the capitals. These capitals bear a greater projection at the side of the nave, to receive the little columns that ascend to the springings of the vaults, always because of that principle,which consists in separating the vertical points of support so as to take a part of the thrusts. (Fig. 34). At C′ we give the horizontal section of the piers C′,at D′ that of the piers D at the level of the triforium, at E′ being the horizontal section of the imposts E and at F′ that of the impost F at the level of the abacuses receiving the great vaults. This general view being presented, let us now examine with care the structure of this nave.

We have already stated, that the architect of the church of Notre Dame of Dijon disposed of a small site, shut in between narrow streets; he could not give to the buttresses of the na- nave, staying the entire system, a strong projection beyond the perimeter of the side aisles. If he had followed the methods adopted in his time, if he had submitted himself to routine, or more correctly, to the rules already established by experience, he would have traced the flying buttress of the nave as indicated by Fig. 79. The thrust of the great vault acting from A to B, he would have placed the last voussoir of the arch at A and its loping at P, and he would have advanced the face of the buttress to C, so that the oblique line of t the thrusts should not pass outside the point G. But he could not leave the limit I; the width reserved for the public street did not allow this; on the other hand he could not internally go beyond the point K, which is vertically over the engaged internal pier L, without having an overhang and breaking the transverse arch M, whose curvature it is important to preserve; for if too great weight acts on the haunches of that arch at N, that arch would push the isolated internal pier in

the direction O P. Then the architect must establish the pier of his flying buttress in the space between K and I'. But we know that this pier must be passive and immovable, for it is the true support of the entire system; it can evidently acqui - re that immobility (Its narrow bearing being assumed) only by a particular combination, the complement to the vertical resistance. Here then is how the constructor solved the problem; he built the pier between the two desired points; (79 bis); he strongly loaded the head of the flying buttress at A, he inclined the coping B C so as to make it tangent to the extrados of the arch, then he brought the rear face of the pinnacle D as an overhang to the point E beyond the surface F, so a that the space P F may be a little less than a third of the space F G. Thus the thrust of the great vault is strongly compressed by the load A, and is neutralized by that pressure; it is then only the flying buttress that itself acts on the pier K, as far as it is loaded at A. If then this arch must be deformed, this would be according to the sketch R; it would break at S and the pier K would be inclined. But the architect recedes his pinnacle, loads the pier beyond its vertical to the point E, i.e., to the point at which the rupture of t the flying buttress would occur; thus he arrests that rupture, for under the load the point S' of the flying buttress cannot rise; but the pinnacle D cannot compress the arch, it does n not load it, since the space O O is greater than the space O P; then the load of the pinnacle, which is a well built homogeneous construction with great cut stones, rests on O C, the ce centre of gravity of the pinnacle being between O and C; then if the arch were demolished this pinnacle would remain s standing; then he loads the pier K with a weight superior to that of the pinnacle having only a width F G; thus he assures himself of the stability of the pier F G, too weak by itself to resist the thrust without the addition of that load, and at the same time he compresses the haunch of the flying buttress at the point where that arch tends to break by rising. The fact is still better proof than all the logical deductions; the construction of the nave of Notre Dame of Dijon, in spite of the neatness of its external buttresses, has not suffered the least deformation. Do not lose sight of the interior; observe that the vaults do not thrust directly on the head

of the flying buttress, and that between the head of this arch and the impost of the vault there exists above the triforium U an internal buttress V only because of that thrust, and that singularly neutralizes its action. Study the details; the block of stone T, against which abuts the last voussoirs of the flying buttress, is only the lintel supporting the buttress first mentioned, and in the height of the same lintel are made the two capitals, that support the side arches of the vault (Fig. 78). This lintel is set exactly at the level of the action of the thrust of the great vault.

Let us dissect this construction piece by piece (80). We see at A the column, the principal support of the triforium beside the piers that caery the springing of a transverse arch and of two diagonal arches, a column flanked by its two l littel columns B. At C are the large shafts set on end, that rest on the abacus of the great capital of the ground story, and that pass before the group A B B to come beneath the course M of the capitals of the arches of the great vault; a course of a single block. At D is the capital of the triforium. At E is the impost of the arcade of the triforium also in one block. At F are the two blocks forming an arcade. At G is the course of the ceiling of the triforium connecting the arcade of the course of the capitals M with the external buttress u under the roof, the buttress whose courses are traced at H. At G′ is one of the slabs set beside G and connecting the rest of the arcade with the wall built beneath the upper windows, with the sill I. These slabs G′ support the drip K covering the roof of the side aisle. At L is the first block of t the external buttress seen above the roof. At M is the course of the capitals of the great vaults bearing the two bases of the little columns set on end for the side arches. At N is t the impost of the great vaults with upper bed horizontal, and that supports the springings of the two diagonal arches and of the transverse arch. At O is the second impost bearing the two diagonal arches and the transverse arch, the upper bed of that being already normal to the curve, while the beds of the two diagonal arches are still horizontal. At P is the third impost block no longer bearing the transverse arch, which is indeoendent, but still bears the two diagonal arches with horizontal upper beds. At Q is the fourth impost block bearing

only the projections behind the diagonal arches for setting the first rubble courses of the filling. At R is the lintel just mentioned, connecting the impost blocks of the pier whose curves are traced at S: this lintel bears the projections behind the diagonal arches, for it is important to shore those diagonal arches already independent, and whose voussoirs are sketched at T, while one of the voussoirs of the transverse arch is shown at V. At X is the course of the external b buttress bearing the end of the window sill, the bases of the little external columns of these windows, and a fillet passing above the fillet at edge of the roof, as indicated by the perspective sketch. The impost voussoir of the flying buttress then abuts against the lintel K, and above that lintel the sp space between the pier S and the vault is solid.(See internal view, Fig. 78).

If we examine the section in Fig. 79 bis, we see that the buttress X, the wall of the triforium Y, the passage Z of the internal pier present a considerable thickness; for the passage is quite wide; the wall and the buttress are together about 2.0 ft, and the group of columns composing the internal pier are 1.6 ft. Now all that must rest on a single capital crowning a cylindrical column. There will evidently be an overhang, and if the buttress X comes to rest on the haunch of the transverse arch of the side aisle, the pressure exerted b by it will push the column to the interior, cause it to lose its vertical position, and once this is lost, the entire equilibrium of the construction is destroyed. The constructor at first gave the capital the form A (81); i.e., he brought the axis of the column into the vertical plane passing through t the middle of the archivolt B. On this capital he placed two impost blocks C D with horizontal bads; the first block C bearing the bases of the little columns set on end, ascending to the springing of the great vaults; the third block F bears the cuts normal to the curves of the transverse and diagonal arches and archivolts, for above that block the arches separate from each other. Freed from the arches, which are then s set as independent voussoirs, the constructor has erected a pier of harp form F G H I K and corbelled out of the buttress L; in the course I he took care to reservetwo projections M to receive the discharging arches supporting the wall N of t

the triforium. The internal pier O, as we have stated, composed of a group of little columns on end, rests on the internal surface of that pier. It is understood that the courses F G H I X are each of a single block of stone and are strong. The heaviest weight and greatest resistance presented is that of the pier O, since it supports vertically the vaults abutted; the buttress L bears almost nothing, for the head of the flying buttress does not load it (Fig. 79 bis), it only equilibrates the structure. Then the stones K I H, being loaded at the ends K′I′H′ cannot tip over; thus the buttress is supported. As for the thrust of the transverse arch P and of the d diagonal arches of the side aisle, it is completely neutralized by the load restiug vertically on the pier O. One now understands how essential it is that the pier O be composed of large stones set on end and not in courses, for that pier supports a double effect of compression; that from top to bottom because of the load of the vaults and that from bottom to top because of the tipping produced by the buttress L on the ends of the stones K I. If then these piers O were built in courses, this might cause the mortar joints strongly compressed by the double action to diminish in thickness; then the least se settlement in the height of the piers O would result in deranging the entire equilibrium of the system. On the contrary, the lever action produced by the courses I and K under the m pier O would have as a result (these piers being perfectly r rigid and incompressible) to very energetically support the springing of the great vaults.

One can better take into account this system of construction by assuming, for example, that there has been employed for executing it cast iron, stone and wood (32). Let a cast iron column and its capital A be set under a stone block bearing a stone impost B. The constructor makes a greater projection toward the nave of the capital than toward the side aisle. O On this capital he erects the courses B C D E F G, etc., with corbellings. He sets three cast iron columns H along the internal surface, doubled by three other columns H′ (see section H″), these columns H H′ are connected to the buttress I by c collars and an anchor K, so as to make the buttress solid with the pier A and to prevent their separation. The buttress I is built in courses of stones. On the columns H H′ the arch-

architect places the imposts L of the great vault; the two l lateral columns O O alone continue to the lintel M, that abuts the arches of the great vault. On the exterior he erects a pier N of stone in order to maintain the internal supports in the vertical by means of the shore P held by the twin ties R to preven its rising. There is no inconvenience in this, on the contrary, if the abutment I built in courses is compressed and settles, for the more the point O is lowered, the more the shore P will be pressed against the tail of the lintel M in a horizontal plane, but especially to give stability to t the column A. Indeed, it is unnecessary to be greatly versed in the knowledge of the laws of equilibrium to know, that if between the column Y and a column S, both being slender (82 bis), we place several horizontal courses, it will be impossible, however loaded the column S, and however well stayed the courses may be in one direction, to maintain these two columns in a vertical plane parallel to the plane of the shores; while placing on a column T (82 ter) horizontal courses V, shored in one direction, and on these courses two supports or columns X X′ passing in a vertical plane perpendicular to the plane of the shores, assuming also that these two columns X X′ are loaded, we could maintain the columns X X′ and T in planes parallel to the shores. In that consists the entire s system of the construction of Gothic naves resting on columns. There is the explanation of the superposed galleries of Burgundian architecture, a sort of open buttress with its internal surface rigid and its external surface compressible, thus giving great power of resistance and bearing for the springings of the high vaults, avoiding enormous spandrels for abutting the flying buttresses, and destroying by its equilibrium and its pressure on two different points the effect of the t thrust of the vaults of the side aisles.

Indeed all that may appear complicated, subtle and labored; but one will indeed recognize with us that it is ingenious, very skilful and wise, and that the authors of this system have made no confusion of Greek art with the art of the North, of Roman art with oriental art, that they have not put caprice in place of reason, and that in these structures is better than the appearance of a logical system. We admit fully that one may prefer a Greek, Roman or even Romanesque construction

to that of the church of Notre Dame at Dijon; but he would i indeed permit us to believe, that more is to be found here f for us, architects of the 19 th century, called to erect very complicated edifices; to play with the material, possessing materials very different by their nature, their properties a and the mode of using them; forced to combine our structures in view of new needs, very varied programmes, very different from those of the ancients; that more is to be taken, we say, than in the primitive structure and so simple of the temple of Minerva at Athens, or even in the concrete and immovable construction of the Pantheon of Rome. It is sad that we cannot always build like the ancients, observing perpetually those simple and beautiful rules of Greek and Roman constructors; but we cannot reasonably erect a railway station, a hall, an assembly hall, a bazaar or an exchange, by following the vagaries of Greek or Roman construction, while the flexible principles already applied by the architects of the middle ages, if studied with care, place us on the modern path, that of incessant progress. This study permits us easy innovation, the use of all species of materials, without derogating from the principles set by architects, since these principles consist exactly in subjecting all, materials, form, arrangements in general and detail, to reasoning; to attain the limit of the possible, to substitute the resources of the industries for inert force, the search for the unknown for tradition. It is certain that if these Gothic constructors had had at command great members of cast iron, they would not have failed to employ that material in buildings, and I cannot but state, that they would have soon reached results more judicious and better reasoned, than those obtained in our time, for they would have frankly taken that material for what it is, profiting by all the advantages it offers, and without occupying themselves in giving it forms other than those adapted to it. Their system of construction would have allowed them to employ simultaneously cast iron and stone, a thing that no person would dare to attempt in our epoch, so much effect has routine on our constructors, who do not cease to speak of progress, like those opera singers, who say "let us go" for a quarter of an hour without stirring from the stage. We do not know that it has been attempted in France until this day, unless in the c

construction of houses of some great cities, to support considerable masses of masonry, vaults of brick or even of stone, good construction well reasoned and jointed, elegant and stable, on isolated supports of cast iron. Indeed classical instruction can scarcely permit these attempts, that the architects of the middle ages would certainly have not falied to m make, and probably with entire success.

As for stopping in the path, this is not what one can reproach Gothic architects, we shall see with what ardor they threw themselves into the application more and more rigorous, of the principles that they had established, and how they arrived in a few years in pushing to the limit those principles, in employing materials with an exact knowledge of their properties, in playing with the most complicated problems of descriptive geometry.

The church of Notre Dame of Dijon is a small edifice, and one could believe that the Burgundian architects of the first half of the 13 th century had not dared to allow themselves similar boldness in monuments of great extent in area and vern nigh. The contrary occurred; it seems that working on a v vast scale, these constructors assumed even more, and developed with even greater freedom their means of execution. The choir of the cathedral of S. Etienne of Auxerre was rebuilt from 1215 to about 1230 over a Romanesque crypt (Art. Crypte), which caused the adoption of certain arrangements unusual in the great churches of that epoch. Thus the sanctuary is surrounded by a simple side aisle with a single square apsidal c chapel. As for its construction it presents a perfect analogy in the lower work to that of the church of Notre Dame of Dijon. Yet at Auxerre the construction is still lighter, and certain differences resultiug from the Romanesque arrangements of the plan, that it was desired not to change, have been solved in the most ingenious manner.

We give (33) the half of the plan of the apsidal chapel placed under the name of the Holy Virgin. This plan is taken at the height of the gallery of the ground story, resting on an arcade, as at Notre Dame of Dijon. At X we have sketched at a smaller scale the horizontal projection of the vault of the side aisle before that chapel. Following the Burgundian method, the side arches are detached from the wall; they rest on

little columns set on end, A B, C D, E F, G H, etc. Middle c columns set on end support the effect of the pressure, and th the vault is composed of two diagonal arches I K, L M, and a transverse arch •O, that of two intermediate arches P Q, R S. These two intermediate arches at the side aisle rest on two isolated columns Q S, set on end and each of a single piece n having 9.5 ins. diameter and 21.7 ft. height from below the capital. The difficulty was to neutralize so accurately the different thrusts acting on these columns Q S, that they could not leave the vertical. This was a problem to solve similar to that set before the architect of the chapels if Notre Dame of Chalons-sur-Marne, but at a much greater scale and with i incomparably more slender supports. Let us place ourselves f for an instant in the side aisle and look at the top of the column S, whose diameter, as we have already stated, is only 9.5 ins. On that column is set a capital with octagonal abacus, large enough to receive the springing of the two arches S T and S R; with two little columns supporting the transverse a arches S Q, S Y. A high impost with lower bed at A (84) and upper bed at B, is reinforced at the angles remaining between the arches and the little columns by bands of leaves. Up to the level of the abacus of the capital C, the arch D of the side aisle rises and already curves by means of two other impost blocks with horizontal beds, while the arch E (intermediate in the chapel) with a greater diameter, rather departs f from the vertical, and above the bed B is composed of independent voussoirs. The little columns F of the transverse arches of the entrance of the chapel are monoliths and shore these imposts, stiffen them, and rest firmly on two sides of the a abacus. Fig. B, gives the section of that springing of the v vaults at the level G H. This construction is bold, it cannot be denied' but it is perfectly stable, since for six centuries and more it has suffered no alteratiou. We see there one of the most ingenious applications of the system of the Gothic v vault, the unequivocal proof of the freedom of the constructors, of their surety of execution, and of their perfect knowledge of the resistance of materials. These little columns are in hard stone from Tonnerre, like the imposts. As for the effect produced by that chapel and its entrance, it is surprising, but without inspiring that anxiety caused by every too

bold experiment. The arches abut each other so well in reality, and also in appearance, that the eye is satisfied. Up to that quadruple band of leaves above the capital that increases the body of the lower impost, all concurs to reassure the observer. But perhaps sone one will object, why are these two columns set at the entrance? Why was not the architect contented by showing a transverse arch from one angle pier of that chapel to the other? To that is only one reply; let us return to Figs. 41, 42, 44 of this Article, and the explanation is given; he did this because of the radiating arrangement of t the side aisle, to obtain on the external ferimeter a greater number of points of support than on the internal perimeter, so as to have transverse arches nearly equal in span and exactly equal in rise to close the triangles of the vaults at t the same level.

If the vaults of the chapel of the Virgin and of the side aisle of the cathedral of Auxerre are arranged like most B Burgundian vaults of the 13 th century, i.e., if their side arches are detached from the walls, and if a slab bearing a gutter unites these side arches to the tops of those walls, the architect of the choir probably did not think this system of construction was solid enough to terminate the great vaults of the principal nave. He must have feared the clusters of this system in a very vast edifice, and he took a mean between the systems of Champagne and of Burgundy.

The Champagne system consists indeed in isolating the side arch from the wall, but turning between this side arch and t the wall a tunnel vault on the extrados of the said side arch. Let us then examine in what consists the Champagne system. We see it at its climax in a little edifice of the Marne, the c church of Rieux near Montmirail. Here first (86) is the half of the plan of the apse of that pretty church. One sees that this plan much resembles that of the apse of Notre' Dame of D Dijon. But we are in Champagne, on the area where resistant materials of great dimensions are rare; thus the little piers A are no longer composed of columns set on end; these are groups of little engaged columns having a section sufficiently large to be built in courses. Further, these little piers are short instead of being tall. Now examine the apse of Rieux. In the interior (87); we see at B concentric tunnel vaults on

the side arches, enclosing the windows and separating the carpentry of the roof and the external cornice.[1] Thus here are two adjacent provinces, Burgundy and Champagne, each strating from the same principle of construction, but in the first of these provinces materials suitable for masonry are abundant, firm, easily quarried in large blocks; the construction exhibits the particular properties of the Burgundian limestone; in the second on the contrary, one finds only beds of chalk, marly stones, not very solid, only quarried in small blocks; the architects subject their mode of construction to the nature of the stones of their province. The church of Rieux dates from the first years of the 13 th century; the sculpture belongs almost to the 12 th century. Champagne is in advance of Burgundy and even of Ile-de-France, when it concerns the development of the principle of Gothic construction. Already the windows of the apse of Rieux have mullions set on end, w while in Ile-de-France, one hardly sees them appear for twenty years later, and in Burgundy only about 1260. The method indicated in Fig. 87 for the construction of the vaults and their supports, is already applied in the absidal chapel of the church of S. Remy of Rheims, earlier by twenty years than the apse of Rieux; it is developed in the cathedral of Rheims, in the vaults of the chapels of the great nave. (Arts. Cathedrale, Fig. 14; Chapelle, Fig. 36).

Note 1.p.151. M. Millet was quite willing to draw for su t this charming and very little known edifice, and perhaps the best type of the architecture of Champagne of the beginning of the 13 th century.

Let us now return to the cathedral of Auxerre; examine the use its architect knew how to make of the two methods of Burgundy and of Champagne. Here (88) is a view of the interior of the high choir; we have assumed one of the great windows to be removed, to allow us to see how the flying buttresses about the vault, and how the internal buttress is pierced at the height of the triforium and the gallery over it. At A is distinguished the tunnel vault turned between the side arches and the archivolt of the windows; but by a concession to the Burgundian system, this tunnel vault does not spring from the capitals B, as in Champagne; it only commences a little higheron a lintel C placed on the side of the internal buttress.

This tunnel vault is here placed on the extrados of the side arch and is independent, while in the construction of Champagne, the tunnel vault and the side arch form but one, or rather the tunnel vault is only a very widi side arch. The mullions of the windows are built in courses, and not composed of columns and tracery set on edge. We give at D the horizontal section of the high pier at the level E; at F the section of the pier at the level G of the triforium. According to the B Burgundian principle, these piers are set on edge in the entire height of the passages. The cornice and the upper gutter are not then placed on a slab roof as in the side aisles of the chapel of the Virgin in the same edifice, but on the arches A. The carpentry of the roof is placed on the side arches. The upper gutter discharges its water on the copings over the tracery, loading and consolidating the flying buttresses. These copings are sufficiently resistant and thick, well supported by the tracery, whose mullions are quite close together, so as to form an actual stone shore opposing its rigidity to the thrust of the vault. Fig. 39 gives an external view of one of these flying buttresses, very well constructed and well s sheltered by the projections and the coping.

Let us leave for an instant the provinces of Champagne and Burgundy to examine how during the same space of time, i.e., from 1200 to 1250, the methods of Gothic construction had advanced in the French provinces, Ile-de-France, Picardy and Beauvoisois.

One of the qualities peculiar to Gothic architecture (and perhaps the most striking) is that one cannot study its form, appearance and decoration independently of its construction.[1] One can deceive with Roman architecture, because its decoration is merely a vestment, that is always perfectly adapted to the thing it covers, one cannot deceive with Gothic architecture, for this architecture is first of all a construction. It is principally in the edifices of Ile-de-France, that one can prove the application of that priuciple. We have seen that in Burgundy, thanks to the excellent quality of the materials a and the possibility of quarrying them in great blocks, the a architects allowed themselves a certaiu boldness, that might pass for being forced. The architects of Ile-de-France or their school cannot be reproached with this defect; the constr-

constructors ahe wise, they know how to keep within the limits imposed by the material, and even when Gothic architecture throws itself into exaggeration of its own principles, they still comparatively retain moderation, which is the stamp of men of taste.

Note 1.p. 155. We have been frequently called tc defend projects of the restoration of Gothic edifices, and to give reasons for the necessary and considerable expenses to save them from ruin. In the very natural hope to obtain economy, men h have often repeated to us:-- "Do only what is strictly necessary, leave to better times the care of finishing, carving t the facing, etc." The reply was difficult, for it would have been necessary to give a course in Gothic architecture to the persons giving us this advice, to cause them to understand t that in Gothic edefices all belongs together, that the stone is set faced and carved, and that really one cannot construct a Gothic monument while leaving something to be done to those who come after us. From the point of view of art, is that then a defect? On the contrary, is it not the finest praise, t that one can give an architecture, after having demonstrated it to say that all constituting it is so intimately connected together, that its decoration makes so much a part of its construction, that one cannot separate one from the other?

The banks of the Seine and the Oise possess excellent beds of limestone, but whose layers are thin when the materials a are hard, thick when soft; at least this is a general law. St Structures erected in these basins are subject to this law.

The entire front part of the cathedral of Paris was erected after the first years of the 13 th century; as for construction, it is an irreproachable work. All members of the immense western facade, superior in scale to all built at that epoch, are accurately subject to the dimensions of the materials employed. The heights of the layers have determined the heights of all parts of the architecture.

So far, in regard to the primitive constructions of the Gothic epoch, we have scarcely given only edifices of moderate dimensions; now procedures that may be sufficient when it concerns the construction of a little edifice, are not applicable when it is necessary to raise enormous masses of materials to a great height. The lay architects of the 13 th century w

were consummate practicians, and understood that law very well, now forgotten in spite of our scientific progress and our theoretical knowledge of the strength and resistance of the materials suitable for building. The Greeks rarely erected but small monuments, relatively to those of the Roman epoch, or if exceptionally the exceeded the ordinary scale, it must be recognized that they did not subordinate the forms to this c change of dimensions; thus for example, the great basilica of Agrigentum known under the name of temple of the Giants, reproduced in colossal size forms adopted in much smaller temples; the engaged capitals of that edifice are composed of two blocks of stone placed side by side. To make an engaged capital by joining two stones side by side, so that there is a j joint in the axis of this capital, is an enormity in principle. In the same monument, the colossal figures, which were p probably set against the piers and formed the second internal order, are sculptured in such thin courses of stone, that their heads consist of three blocks. To make a statue or caryatid, even if colossal, by means of superposed courses, is again an enormity for a true constructor. The joints were concealed under painted stucco, which disguised the poverty of t the jointing; from our point of view, placing ourselves in t the place of Gothic construction, ignorance of the principle is no less evident. But it is necessary to judge the arts by applying to them their own principles, not by applying to t them principles belonging to foreign arts. We are not here conducting a trial against Greek architecture; we only state a fact, that we demand that men judge Gothic architecture by taking its own elements, its code, and not by applying to it laws not made for it.

The Romans had only a single mode of building applicable to all their edifices, whatever their dimensions; our readers k know already, that the Romans cast their edifices in or on a mould, and faced them with a purely ornamental covering, that adds or detracts nothing nothing from its stability. That is excellent and reasonable; but that has no relation to Gothic architecture, whose appearance is only the result of the construction.[1]

Note 1.p.157. Perhaps we may be accused of repeating ourselves in the course of this work; but the prejudices it is nec-

cessary for us to combat are only the result of error or of
lse appreciation repeated with unusual persistence. In such
case, in order to make its rights apparent, truth has no o
her resource than to employ the same tactics.

Let us return to our starting point. We shall say then, that
e Gothic architects of the 13 th century subjected their m
de of construction to the dimensions of the edifices, that
ey desired to erect. There is a very simple law that all c
n understand without having the least notion of statics; it
this; building stones being given and having a height of
ver 15.7 ins., for example, if we build a pier 10.5 ft. high
th these stones, we shall have 9 parallel beds in the height
the pier; but if with the same materials we build a pier
.0 ft. high, we shall have 17 beds. If each bed joint suffers
depression of 0.39 in. for the small pier, the settlement
ll be 3.5 ins., and for the large pier 6.7 ins. Again it is
cessary to add to this settlement resulting from the number
bed joints a greater weight, which adds a new cause of set-
ement for the large pier. Thus the more the constructor pi-
s the stones on each other, the more he increases the chan-
s of settlement, because of cracks and of instability of the
fferent members of his edifice, since if that be enlarged,
e materials are the same. These differences are not sensib-
in edifices differing little in dimensions, or when one c
nsents to place an enormous excess of strength in his struc-
res; but if he only wishes to put in the work just the quan-
ty of materials necessary, and if with the same materials,
e desires to erect a facade like that of a village church,
d like the facade of Notre Dame of Paris, he will understa-
the necessity for adopting particular arrangements in the
eat edifice, so as to oppose the greatly multiplied chances
settlements, ruptures, and consequently of a general dislo-
tion. We have already seen how primitive Gothic constructo-
found a resource against settlements and deformations res-
ting from the use of stones on edge, to strengthen the high-
t piers, built in courses. We have also shown how during t
e Romanesque epoch, the constructors had enclosed a concre-
within the facing of stone retaining externally the appear-
ce of a structure of large blocks. The Gothic architects,
ving experienced the insufficiency of this procedure and i

s little cohesion, substituted masonry of small stones for ncrete, and claimed to give it strength and especially stif- ess by joining to this great isolated blocks of stone, only mented at certain distances to the body of the structure by urses set on their beds and penetrating deefly into that s ructure. Stones set on edge compose the columns, bonding c urses bases, rings, capitals,friezes and bands. This is the igin of these basement arcades, and those arrangements of ttle columns placed against the surfaces, and often of tho- perforated facings, that decorate the heads of the external ying buttresses or of walls. The facade of the cathedral of ris supplies us with beautiful examples of this mixed cons- uction, composed of courses and of facings set on edge, wh- e function is so frankly emphasized, and that presents such illiant and ornamental motives. It is true that it is neces- ry to have been called to dissect these structures to recog- ze their practical sense; nothing is more simple in appear- ce as a structure, than the enormous facade of Notre Dame Paris, and this is one of its qualities. In seeing such a ss, one cannot suppose it nece sary to employ certain arti- ces, very labored combinations to give it perfect stability. seems as if it would have sufficed to pile up courses of tone from base to ridge, and that this enormous mass must intain itself by its own weight. But we repeat, that to er- t a facade 65.6 ft. high or one of 19/.0 ft. are two differ- t operations, and the facade of 65.6 ft, perfectly stable d well combined could not maintain itself upright, if its mensions were tripled in all directions. These are laws that actice alone can make known. It is unnecessary to make com- ex calculations to understand, for example, that a pier with horiontal square section of 10.8 sq. ft., and whose height 32.8 ft., gives 353. cu. ft., resting on a square surface 28 ft. side; that if we double the height of this pier, its ickness and width, although the ratio of its height and ba- are similar, to that of the first pier, we shall obtain a uare area 6.6 ft. side, 43.2 sq. ft. area, and a volume of 6 cu. ft. In the first case the ratio of area to volume is / 10; in the second 1 : 20. Thus the ratio of loads to the eas are in an increasing proportion as the scale of the ed- ice i enlarged.[1] This primary rule being established, in t

in the construction of very large edifices appears a difficulty, that still increases the effect of the loads produced by the increase of volume. If the materials do not exceed a certain height of quarry layer, their dimensions in length and width are likewise limited; it results from this, for example, that if one can erect a pier having an area of 10.8 sq. ft., in its horizontal section by means of courses, each of a single block of stone, it will not be the same when a pier will have 43.2 sq. ft. in horizontal section, for one cannot procure courses of that dimension. Thus in increasing the scale of an edifice, on the one hand is changed the ratio between the volumes or weights and areas, on the other one cannot obtain a complete homogeneity in the parts composing it. A new case of rupture and dislocation. To avoid the danger resulting from too great a load resting on too small an area, naturally one is led to increase this area at the base, free to dominish it as the structure rises, and the loads become comparatively less. The type most nearly approaching this principle is a pyramid; but a pyramid is a pile and not a structure.

Note 1.p.158. We have sometimes found architects very surprised to see the piers of their churches crush under the load, saying:-- "But we have followed exactly the relative proportions of such edifices, and have employed materials of like r resistance; Gothic construction really offers no security." One might reply:- "No security it is true, if one will increase or diminish the scale while retaining the relative proportions; Gothic construction demands that one takes time to study it, and to know its principles, and Gothic architects were wrong to invent a system of constructinn, which must be known and reasoned to be applied."

Assume a tower erected on four wallu, in section this tower presents Fig. 90. We have given to the walls at the base a t thickness sufficient to resist the pressure of the upper parts, and as much to reduce this pressure as not to pile up materials uselessly, we have successively reduced the thickness of those walls as our structure is elevated. But the entire load rests on the surface C D, and if the increase in strength D E F be not perfectlw bonded, does not accurately combine with the load A B, the greatest settlement being from A to B, there will appear cracks, first at I, later at G; this increase

of strength D E F that we added will be more ingenious than u useful, aud the entire weight then coming to effectively load the surface C D, the inner surface of the wall will be crushed. If ourtower is very high, it will be easy to bond it perfectly, the external with the internal surfaces, by means of long stones, making a homogeneous masonry, and then the base C E will actually bear the entire load; but if our tower be very high, if its mass be colossal, whatever precautions we may t take, the structure being composed of a considerable number of stones, we can never bond the two surfaces with sufficient accuracy as to resist that difference of pressure exerted at the interior and exterior, our masonry will have separated, and the effects just mentioned will be produced. It is then necessary to employ artifice. It is essential to act so that the external surface being less loaded must present a stiffness superior to the internal surface, and that at the recessions may be a very strong connection with the mass of the structure. In other terms, it is necessary for the external surface to shore the body of the masonry, and to produce the effect made apparent by Fig. 90 bis. Now that is not easy when one only has stones all being of nearly the same dimensions. Yet the architect of the facade of the cathedral of Paris attained that result by the very wise and well calculated combination of its construction. He commenced by establishing each tower, not on solid walls, but on piers (see plan of cathedral of Paris, Art. Cathedrale), for it is easier to give homogeneity to the construction of a pier than to that of a wall. These external and initial piers are built in courses of hard stone, regular and carefully leveled, enclosing excellent concrete composed of large stones set in a bed of mortar. The internal pier is abutted in all directions since it is internal, and it supports a vertical load; but the piers on the exterior, toward the place on the side, must have been shored by powerful footings. Now the entire construction is well faced with long stones inside and outside, and from the substructure to the base of the tower, the buttresses are built as indicated by Fig. 91.

It results from the method employed, that although there m may have been a much greater pressure exerted on the internal surface (where the dotted line A B indicates the depth through

the jambs of the openings at different heights) than on the external surface of the buttresses, and that in consequence of that pressure, one can note a sensible settlement inside, all the loads are transferred by the arrangement of blocks of stone sunk in the thickness of the concrete, forming as indicated in Fig. 91 bis a superposition of angles like saw-teeth, so that the load C D rests on the base E F, load H G on base I K, load I L on base M N, and so on to the base of the buttress. But since in fact settlement must occur between the points E G, I L, M O, P R, it results from this that the projections G F, L K, O N, R S, come to bear very strongly on their angles F, K, N, S on the external surface V; since this surface is a smaller depression than the internal surface, because less loaded and fulfils the o fice of shoring, that we have indicated in Fig. 90 bis.

Now that we no longer erect these colossal structures composed of very different parts, we rarely suspect the effects manifested in such circumstances, and we are very much astonished when we see them occur, causing the most serious disorder. It is easy to reason theoretically on these enormous loads unequally distributed; but in practice for lack of precautions in detail, and leaving the execution of routine methods, we are most frequently compelled to recognize our powerlessness, to blame the art that we profess, the soil on which we build, the materials, contractors, all and everybody, except the perfect ignorance in which it is desired to leave us, under the pretext of preserving classical traditions. We freely admit that the architecture of the Romans may be superior to Gothic architecture, and still more freely, that for us the architecture of the Greeks, Romans, and of the middle ages is good from the moment that it remains faithful to the principles accepted by each of these three civilizations; we shall not dispute on a matter of taste. But if we desire to erect monuments in imitation of those of antique Rome, it is necessary for us to build as the Romans built; having space, slaves, a powerful will; to be masters of the world, to seek men and take materials wherever it seems good to us. Louis XIV took the part of the Roman constructor seriously, even to pretend sometimes to build like a Roman. He commenced the aqueduct of Maintenon like a real emperor of the ancient city; he began

ithout the power to complete it. Money, men, and more than ll that, imperious reason was lacking. In our great works o f railways, we also approach the Romans, and this is what we ave done best; but for urban structures, the monuments or h abitations of our cities, when we pretend to imitate them, e are only ridiculous, and we should do more wisely, it see- s to us, to profit by the elements employed among us with eason and success by generations of artists, who adopted pr rinciples in accord with our needs, means, materials and mod- rn genius.

We have already said enough of the construction of the mid- le ages to make understood wherein its principle entirely d iffers in principle from Roman construction, how the proced- res suited to one cannot suit the other, how the two methods re the result of civilizations, of opposed ideas and systems. Having accepted the principle of equilibrium, of forces acting nd opposed to each other to attain stability, the construct- rs of the middle ages, because of the tendency natural to m man to abuse everything, must come to exaggerate in the succ- essive applications of these principles, what he could have of good, reasonable and ingenious. Still we repeat, abuse ma- kes itself felt less in the provinces of the royal domain, a and especially in Ile-de-France, than in the other provinces into which the system of Gothis construction had penetrated.

What is easily recognized, is that already at the middle of the 13 th century, constructors made a sport of those questi- ons of equilibrium so difficult to solve in edifices of very great dimensions and frequently composed of weak materials. In the North they built only in stone; but they employed si- multaneously in the same edifice cut stone in courses, set on its quarry bed, large rubble flushed with mortar, a mass com- pressible at need, and blocks set on edge, rigid and inflexi- ble struts, capable of great assistance in certaiu cases. El- asticity being the first of all conditions to be satisfied in monuments erected on slender supports, yet it was necessary to find besides this elasticity a rigidity and an absolute re - sistance. It is by the lack of having been able or having de- sired to apply this principle in all its rigor, that the cath- edral of Beauvais could not maintain itself. There elasticity is everywhere. That monument may be compared to a wicker cage.

We snall soon return to it, for even its defects are excellent for instruction. Let us not leave so soon our cathedral of P Paris. The section of one of the buttresses of the towers sufficiently shows that the constructors of the beginning of the 13 th century did not pile stones on each other without foresight, and without taking into account the defects produced in such great edifices by the laws of gravity. Their masonry lives, acts, fulfils its function, and is never an inert and passive mass. Today we build our edifices somewhat as a sculptor makes a statue; provided that the human form is passably preserved, that suffices; it is no less an inorganic block. The Gothic edifice has its organs, and laws of equilibrium, and each of its parts concurs with the whole by an action or a resistance. Everyone cannot see the interiors of the buttresses of the towers of Notre Dame of Paris, and we foresee t the objection, that has been sometimes made to us; that our imigination causes us to attribute to those artists of past centuries intentions, that they never had. Let us take for t those difiant minds an example, which they can verify with t the greatest ease in the same monument. The great vaults of the nave of the cathedral of Paris, as all can see, are composed of diagonal arches comprising two bays and crossed by a transverse arch; this is the primitive system of Gothic vaults developed at length in this Article. It results from this combination that the piers of the great nave are loaded unequally, since alternately they receive a transverse arch alone or a transverse arch aud two diagonal arches, and still the piers of the great nave are all of equal diameter. There is something that shocks the reason, particularly in a very large edifice, since these unequal loads must produce unequal settlements, and if the piers receiving three arches are strong enough, those receiving but one are too strong; on the c contrary, if those receiving only one arch are of proper diameter, those receiving three are too slender. Apparently there is nothing to object to that cirticism, and we must confess t that we were long in explaining to ourselves such an apparent forgetfulness of the simplest principles among artists always proceeding by reasoning.

Yet see what proves to us, that it is unnecessary to hasten to give judgment on an art, that one has hardly commenced to

gravel. Let us enter the side aisles of the cathedral, doubled in the nave asoaround the choir; but not in passing, that each aisle was built 15 or 20 years after the choir, and that the architects of the beginning of the 13 th century, who built them profited by the faults committed by their predecessor. We observe that the piers separating the double side aisles of the nave are not all similar; in pairs we se alternately the cylindrical column composed of stone drums, and the central column likewise composed of drums, but surrounded by ten little columns set on end and each of a single piece. (See plan, Fig. 92). Why is that difference in construction? It is caprice or fancy? However little one has studied these monuments, he will remain convinced that caprice does not enter into the combinations of constructors of this epoch, particularly if this concerns an architectural member as important as a pier.[1] The question being stated, "why this difference?", with some attention we shall solve it soon. These intermediate piers A surrounded by little columns on end are in line with the columns of the great nave receiving the heaviest loads, i.e., a transverse and two diagonal arches. Now it is first nelessary to know, that originally the flying buttresses of the nave w were not those seen today, which date only from the second h half of the 13 th century. Those primitive flying buttresses were double span, i.e., they rested at first on an intermediate pier placed on the piers A B of the double side aisle, a and they were abutted in their turn by secondary flying buttresses over the spaces A C, B D. (See Art. Cathedrale, Fig. 2, giving the section of the nave of Notre Dame of Paris). Certainly the flying buttresses intended to abut the ends of the transverse and diagonal arches of the great vaults were stronger than those designed only to abut a single intermediate transverse scarcely loaded arch. Perhaps even the intermediate transverse arch of the great vaults was not abutted by a flying buttress, which would have prevented the vaults from retaining their curvature, since in the two transepts we still see single transverse arches, thus left to themselves, that are not deformed. The preceding explanations contained in t this Article have shown that the vertical pier supporting vaults only plays a secondary part, and that a great part of t the weight of the vaults supported by the flying buttresses

rests on the abutmentsof these flying buttresses. Then it would be reasonable to give to the piers intended to support t the piers on which rest the flying buttresses, or at least f flying buttresses more powerful than the others, a greater resistance. but if the architect had given a little greater diameter to the piers A than to the piers B (Fig. 92), then these piers would still have been compressed by the very great load they must support, and their settlements would have occasioned very serious disorder in the upper works, the rupture of the flying buttresses, and consequently the deformation of the great vaults. Still the architect did not wish to give those piers A a diameter such, that they would have made the construction of the vaults of the side aisle difficult, and produced a very ungraceful effect; then as always, he used artifice, he surrounded his cylindrical piers, built in courses, by little columns set on end, he enclosed the drums by ten strong and incompressible struts (93), certain that this system of construction could suffer neither settlement nor d deformation, and that consequently very strong flying buttresses weighing on these piers could suffer no deflection. This arrangement had also the advantage of leaving above the capitals, between the transverse and diagonal arches, a strong course F resting directly on the central column.(Fig. 9).

Note 1.p.165. Caprice is one of these explanations accepted in many cases, when one speaks of Gothic architecture; it has the advantage of reassuring the minds of persons, who love b better to cut by one word a difficult question, than to attempt to solve it.

The method consisting in employing the materials (stone) e either on bed or on edge was rapidly perfected during the first half of the 13 th century. There is indeed a resource, to which we,who,desire to claim to have invented everything, have recourse daily, since we use cast iron in our structures with much less intelligence, let us say, than did Gothic constructors, when they sought to obtain incompressible and rigid points of support by employing certain stones of excellent quality.

Let us examine other applications even better reasoned still on these principles. The choir of the cathedral of Amiens, bu built some years before that of Beauvais, from the point of view of Gotnic construction is a masterpiece, particularly in

the lower works.[1] Let us first examine the piers of the sanctuary of Notre Dame of Amiens. These piers give in plan a great cylindrical column having 3.94 ft. diameter with four engaged columns, three with diameters of 1.45 and one with a diameter of 1.15 ft. These four columns are only engaged one fourth in the middle column. The abacuses of the capitals are traced to exactly receive the arches of the vaults, as appears in Fig. 94, and the sections of these arches are themselves cut according to their functions. The archivolts A are composed of a double series of voussoirs, they support the wall. The transverse arches B of the side aisles, which only support the vault and stay the construction, have a more slender profile, and all their resistance presents itself at one side like a rib. The diagonal arches C are moulded on the same principle, but finer than the transverse arch, and the load they support being lighter and their function less important. A s single impost block, the first one D, has its upper bed horizontal, above this impost block each separates and forms voussoirs independent of each other. One will observe that the t triangles E of the fillings of the vaults rise vertically to the point where their meeting with the extrados of the second arch F, having the function of the side arch, permits them to follow its curve. Assume a horizontal section of that construction at the level P and we obtain Fig. 95, on which we have traced by white and dotted lines the construction of the combination of the alternate jointing of the courses. At S is a mass solidly built and not concrete, but by means of superposed horizontal courses supporting the overhang of the buttress of the upper gallery; If we cut the pier vertically in its a axis M N, we find this construction (96). A is the level of the capitals at the springing of the vaults of the side aisle; B is the impost of these vaults with its temporary tie R, placed only during construction, so as to prevent the bending of the pier and to arrest the thrust of the lateral arches until these piers are loaded (Art. Chainage), C is the transverse a arch, which is free; D are corbelled courses receiving the b buttress F of the gallery of the second story. This buttress is composed of large blocks of stone set on edge, and is connected to the main pier I by an intermediate lintel F. At G is the course forming the covering of the gallery, the upper

passage at the level of the sills of the upper windows and tie. At H is the isolated column composed of large pieces of stone like the buttress and consequently rigid, that recieves the head of the flying buttress. The entire load is thus transferred to the pier I, first because on that pier spring the arches of the vaults, then because the butttess E as well as the column H, being composed of stones set on edge, the settlement andthe load consequently come on that pier I. That load being much greater than that resting on the buttress E, it results that the corbelled courses E completely destroy the tip or o overhang of the buttress E. The transverse arch C is free; it cannot be deformed by the pressure of the pier E, since that does not act on its haunch. This construction is very simple; yet it was necessary to invent it; but here is what indicates the extraordinary sagacity of the masters of the work of this so remarkable a part of the cathedral of Amiens. The side aisles of the radiating chapels of the apse of that edifice give in that plan above the bases, Fig. 97. The flying buttresses that abut the thrust of the upper vaults have a double span, i.e., they rest on a first pier placed on the group A of columns, and on a second pier placed on the abutment B. In section on C B, these flying buttresses present the profile (98). This section clearly shows, that if the load resting on the piers C is considerable, that on the piers A is still greater. because it is active, produced not only by the weight of the buttress D, but also by the pressure of the flying buttress. Every structure composed of courses settles, and this settlement is the more pronounced the greater the load. A settlement produced in the pier C would have no danger if the piers A s settled less, for on examiniing the sections in Fig. 98, one will see, that the settlement of an inch or so in the pier C, if the pier A resists, would only have the effect of pressing the flying buttress more against the haunches of the upper v vaults and holding together the structure more powerfully by pressing it toward the interior, sence it is polygonal in plan; but it is necessary that the pier A does not settle as much as the pier C. The entire resistance of the construction is subject to that condition. Now see how the constructors have solved this problem. The piers C were built with courses separated by beds of thick mortar, according to the method of

the masons of that epoch; on the contrary the piers are composed of clusters of columns built of large blocks of stone, a sort of struts (to use a term of carpentry), that cannot settle like numerous courses set on beds of mortar. Not wishing to give these piers A a wide bearing, so as not to encumber the entrance of the chapels, it was the best means to render them rigid under the load that they must support, to compose them of a cluster of columns nearly monolithic, and thus diminishing the number of joints, to avoid all cause of settlement. Observe that the materials at command of the architects of Picardy could be set on edge with impunity, and that if t they had built the piers A of several blocks, that is because thew could not procure monoliths 32.8 ft. high; they have taken the largest stones that they could find, varying from 3.3 to 7.6 ft., while the piers C are composed of courses 1.6 to 2.0 ft. high.

Note 1. p.167. See in Art. Cathedrale the historical summary of the construction of Notre Dame of Amiens. The upper parts of the choir could only be completed with insufficient resources.

At Amiens theory and practice were right in the difficulties presented by the erection of a nave 49.2 ft. between axes of piers with 139.4 ft. beneath the crown, flanked by side aisles 23.0 ft. inside by 48.3 ft. high to the crown. This vast s structure has retained its bearing, and the movements necessarily produced in such an extensive structure have not changed its stability. Then the architects renounced cross vaults comprising two bays (hexapartite); desiring to distribute the t thrusts equally to the points of support separating these bays, they adopted after 1220 rectangular cross vaults according to the plan (99); this was more logical; the piers A M I H were alike and the buttresses B also similar, the flying buttnesses have the same strength. The constructors changed formulas; their artistic feeling must have been shocked by those cross v vaults on double baysappearing to transfer the loads to alternate piers, and whose diagonal arches C D by their inclination masked the windows opened at C'E beneath the side arches. Further as we have stated before, these diagonal arches on a very long diameter C D compared to the diameters of the transverse arches C F, obliged them to raise the crowns G much, which i interfered with placing the tiebeams of the carpentry, - -

or required a considerable height of the eave walls above the side arches C E. In turning the cross vaults by bays, the diagonal arches A H being round, it was easy to arrange that the crowns L of these arches should not be above the level of the crowns of the transverse arches A I, M H, that were pointed.

Our readers know enough now, we believe, to understand in its entirety as well as in its details, the construction of a great church of the 13 th century, for example such as the cathedral of Beauvais. To avoid repetition and to summarize the scattered methods of which we have given an idea, we are gonig to follow step by step one of those great structures f from the foundations to the carpentry of the roofs. If we s select the cathedral of Beauvais, this is not because that e edifice is perfect in execution, but because it is the truest and most absolute expression of the theory of the constructor about the middle of the 13 th century. This edifice partly f fell less than a century after the completion of the choir; yet it was conceived in a fashion to be able to remain standing for centuries. The catastrophe that completely changed i its character was caused by poor execution, the lack of rigid points or their too weak resistance, and especially by the nature of the materials, which were neither sufficiently large not solid enough. If the architect of the choir of Beauvais had possessed the materials of Burgundy, those employed at D Dijon and Semur, for example, the fine limestones of Chatillon-sur-Seine, or again the stone of Montbard, Anstrude or Dornecy, or even what would have been possible, the stones of Laversine, Crouy, and certain hard layers of the basins of the Oise or Aisne, the choir of Beauvais would remain standing. The master of works of Beauvais was a man of genius, who desired to reach the limits of the possible in stone construction; his calculations were correct, his combinations profoundly sagacious, his conception admirable, he was badly seconded by the workmen, and the materials placed at his disposal were insufficient. His work is no less the subject of very precious studies, since it supplies us with the means of knowing the results to which the system of construction of the 13 th century could attain. We have given in Art. Cathedrale, Fig. 22, the plan of the choir of Beauvais. This plan, if compared to that of the cathedral of Amiens, shows that the two parallel

bays adjoining the piers of the crossing are narrower than the next two; the constructor thus avoided too active thrusts on the two piers of the transverse aisle forming the entrance of the choir. As for the succeeding bays, they have an unusual width (nearly 29.5 fta between the axes of the piers). The n need of giving free spaces is so evident at Beauvais, that t the piers of the semicircle do not have little engaged columns at their sides to receive the archivolts, but only radially to receive the ribs of the greater vaults, the transverse and diagonal arches of the side aisle. According to the method of the constructors of that epoch, when they were not turned aside from their theories by questions of economy, the f foundation of the choir is admirably built. The chapels rest on a solid circular mass faced with cut stone, as at the cathedral of Amiens, presenting externally a strong footing also faced with well dressed ashlars set in a bed of mortar. This wall of solid masonry is connected with the wall that supports the isolated piers by radiating underground walls.

At the cathedral of Amiens, where we have been able to examine the foundation down to the good ground, we found outside the profile (100). At A is a layer of brick earth 1.3 ft. thick laid on the virgin clay; at B is . deb of concrete 1.3 ft. thick, then from C to D are 14 courses of 1.0 to 1.3 ft. thickness each, of ashlars from the quarries of Blavelincourt n near Amiens. This stone is a chalk full of lints, very strong, that is quarried in large blocks. Above is found a course E in stone from Croissy, then three courses of sandstone below the external ground. Above the external soil the entire edifice rests on six other courses of sandstone well surfaced and of extreme hardness. Behind the facings of the foundation is a concrete of large fragments of flint, of stone from Blavelincourt and Croissy, embedded in a very hard and well made mortar. On this artificial rock rests the immense cathedral. At Notre Dame of Paris, the foundations are likewise built with the greatest care, the whole resting on good ground, i. e., on the lower sand of the Seine, which is coarse and greenish. As for the piling claimed to exist beneath the masonry of most of our great cathedrals, we have never found traces of it.[1]

Note 1.p.177. It is with these piles of Notre Dame of Paris,

of Notre Dame of Amiens, with so many other fables, repeated for centuries concerning the construction of Gothic edifices. It would not be possible to construct a great cathedral on p piles. These edifices could only be founded on broad footings; the points being very unequal in elevation, the first condition of stability was to find a perfectly homogeneous and resistant mass below the ground.

Not let us return to Notre Dame of Beauvais. We have given in Art. Arc-Boutant, Fig. 61, the entirety of the system adopted for the construction of the flying buttresses of the apse of the cathedral of Beauvais. It is necessary to return to t the details of that construction, one will see how the architect of this choir attempted to excel the work of his colleague at Amiens. Yet these two apses were built at the same time, that of Beauvais being perhaps later by some years. We a assume, as we have just done for a flying buttress of the choir of Notre Dame of Amiens, a section made through the axes of the piers of the apse of Beauvais (101). It is interesting to place in parallel these two sections, so we give this at the same scale. At Amiens the piers of the sanctuary are 45.9 ft. high from the pavement of the side aisle to the abacus of the capitals receiving the arches of the vaults of the side a aisles; at Beauvais the same piers are 52.2 ft. high. But at Amiens the apsidal gables have the entire height of the side aisle, while at Beauvais they are muct lower, and between the terrace covering them and the vaults of this side aisle exists a gallery, a triforium F. At Amiens the intermediate pier possesses a passive resistance, rigid, due to its mass and to t the system of construction of the lower piers, as we have just demonstrated; the second pier is only an extra for safety, an excess of precaution, though necessary. At Beauvais the master of the work claimed to give this intermediate pier an active and real resistance, and to transfer to the second and external pier that passive resistance, that it is always necessary to find somewhere. He thought to be able thus to obtain more lightness in the entirety of his construction, more height a and more stability. As we have just stated, the piers E of t the sanctuary have more space and are thicker than those of Amiens in the direction of the thrusts. The cluster of little columns supporting the diagonal and side arches of the high

vaults are corbelled out on the lower capital G. The bearing H I is then greater, and the buttress K of the great triforium rests vertically on the lower pier. On this buttress of the triforium, it is no longer a single column that rises, as at Amieus, to receive the head of the flying buttress, these are two little twin columns set on end, as shown by the horizontal section A′ made at A B. These little twin columns relieve the lintel L, that was a course forming the ceiling. Two other l little columns were placed between this lintel course and the head of the first flying buttress, whose head rests against an enormous block of stone M, loaded by a cornice course and a pedestal H supporting a colossal statue. Two little twin c columns are again set before that statue, between the first and second flying buttresses. These last small columns do not bear the head of this flying buttress, but a pinnacle whose form and construction we shall soon indicate. This entirety recalls nearly what we have seen at Amiens. But we observe t that all this system of double construction rests vertically over the lower pier, the internal portion being built in cour-ses and the external one in great rigid blocks set on edge, so as to stiffen that entirety, so slender and high;[1] we again observe that the very strong lintel L, the block M and its l load N, evidently tend to add a considerable weight at the t top of the lower struts to maintain it in the vertical, and to make quite real its function of a strut. Here is the inter-nal pier made as rigid as possible, it now acts to resist the thrust of the vault exerted at a great height.The architect did not think himself satisfied by a single flying buttress as at Amiens, were it surmounted by rigid tracery; he was right for at Amiens in the parallel parts of the choir, that received three vault ribs instead of but one, these flying b buttresses with tracery were raised by the pressure of the v vaults, and in the 15 th century it was necessary to turn new flying buttresses beneath those of the 13 th. But see now the master of works at Beauvais made proof of a boldness without example, and at the same time of a rare sagacity. One sees t that the intermediate pier O does not stand vertically over the pier P at the head of the chapel, as at the cathedral of Amiens, but its axis is vertically over the internal surface of that pier P. let us at once say that this pier O, whose

orizontal section C D is given at C', transmits more weight oward its surface C than to that at D. Its centre of gravity s then within the dotted line R, i.e., on the pier P. Still his pier is thus in equilibrium, tending rather to incline t oward the interior than toward the great external buttress, hen by its position it comes- 1, to support the thrust af the wo flying buttresses; 2, to add to the resistance offered by nese flying buttresses and tendency to incline toward the ch hoir. The vertical pier O thus has the function of an oblique hore. If this active resistance does not suffice(and it could ot suffice), the pier O is maintained in its turn in its fun- tion by the two last flying buttresses S T and the great pas- ive buttress. But it may perhaps be objected, why that inter- ediate pier? It is because the great external buttress could ot abut the thrust of flying buttresses of such great radius nless doubled, and that due to the intermediate buttress O, t only has to abut a diffused pressure, almost nothing.

Note 1.p.119. In the 14 th century the little columns set on he triforium being broken were replaced by a solid pier (Art. rc-boutant, Fig. 61), but one can now recognize their posit- on and nearly their dimensions.

To clearly explain the function of the pier O, assume that e have to shore the choir of Beauvais; assume that we have or making this shore only the great buttress; if (101 bis) e place our shores as indicated at A, we shall certainly over- urn the buttress C; but if inside that buttress C we place n intermediate shore D E, as in the sketch B, slightly incl- ned toward the choin, but kept in a vertical plane passing hrough the axes of the piers on the radius of the sanctuary, nd that from that shore we place two shores G against the ault, then two other shores H I, we shall no longer have to ear the effect of the thrust of the vault V on the great but- ress C, for the intermediate shore D E will sustain a great art of the thrust of the two shores F G, and transfer it to ts base D. There is the entire problem set, and which has b een solved by the architect of the choir of Notre Dame of B Beauvais. Unfortunately the execution is defective. Yet it is ertain that this enormous edifice would have retained perfect stability, if the architect had made the little twin columns bove the triforium stronger and more resistant, for example,

if he could have made them of cast iron. The disorders that have manifested themselves in the construction have all come from that; These little columns were too slender and have broken, for the could not resist the load brought on them when the internal piers came to settle because of the drying of t the mortar. Breaking, the lintels I broke (Fig. 101), the great blocks M tilted, resting too heavily on the head of the flying buttress, that was deformed, and the vault following the movement, the pressure on these flying buttresses was such, that they nearly all bent, their effect became nothing, because the upper flying buttress loosened slightly, since t the vault no longer pressed against it. Equilibrium was destroyed; it was necessary to do considerable work to prevent an entirel fall of the edifice. Fig. 101 ter giving in perspective the tops of this buttress receiving the head of the flying buttress, shows us very well the intention of the master of works was to obtain by the piers of the choir of the cathedral of Beauvais and under the flying buttresses, buttresses o open but perfectly rigid, so as; 1, to load as little as possible the lower piers; 2, to cause that the settlements of the internal parts built in courses, stiffened by little columns set on end, should naturally transfer the loads inward. From this example and from those pertaining to Gothic construction, properly so-called, proceeds this principle, viz:- that every structure erected by means of superposed courses in great number should be stayed, stiffened by the addition of monolithic enclosing, flanking and staying the piers composed of superposed stones. This principle was scarcely applied by the Romans, who had no need to resort to it, it belongs to the Gothic constructors. Of this principle, they made one of the most common motives of decoration of edifices, and indeed it lends itself to the most brilliant and boldest combinations.

Certainly there are grave defects in the example of construction just given to our readers, and we do not conceal them. This external scaffolding of stone, that forms the entire strength of the building, is subject to storms; it seems that t the constructor, instead of protecting the essential organs of his monument, took pleasure in exposing them to all chances of destruction. His system of equilibrium depends on the absolute resistance of materials too frequently imperfecta He

evidently desired to astonish, and he sacrificed all to that desire. But beside such serious defects, what thorough knowledge of the laws of equilibrium! What subjection of matter to the idea, what a theory fertile in applications! Do not imitate these subtle constructions, but let us boldly profit by so much acquired knowledge. To profit by it, it is at least necessary to cultivate and practise it.

In Art. Chainage we have indicated what were the procedures employed to tie together edifices in the middle ages. For the longitudinal timbers used during the Romanesque epoch, the constructors of the 13 th century, perceiving that these quickly decayed, substituted iron cramps connecting the stones forming the courses. However this method was only employed in Ile-de-France with a singular exaggeration. There are some monuments like the S. Chapelle of the Palace at Paris, where all the courses from bottom to top are cramped together. Even at Notre Dame of Paris, it was perceived that all the constructions erected or repaired after the first years of the 13 th century, at heights quite close, were connected by cramps cast in lead. Certainly those constructors did not have entire confidence in their methods so ingenious, and their natural good sense made them already feel, that they pushed this boldness too far. The manner in which they arranged these ties further shows well, what they feared most was the bending or twisting of the piers and walls, and that in that the system of stone struts adopted by the Burgundian architects had a marked superiority over the dangerous use of iron cramps sealed in solid stones. It must be said also, that the constructors of Ile-de-France procured long stones with difficulty, while in Burgundy they were common and of excellent quality.

It is now time to entertain our readers by an edifice, which in itself summarizes, while exaggerating them with great skill, all the theories of constructors of the Gothic school. We wish to speak of church S. Urbain of Troyes. In 1261 Jacques Pantaleon, a native of Troyes, was elected Pope under the name of Urban IV at Viterbo; he died in 1264. During his pontificate, he desired to erect at Troyes a church under the name of S. Urbain; this monument was commenced and rapidly erected, yet it remained unfinished, the successor of Urban probably not having regarded it best to continue the work of

his predecessor. Such as it is, the church of S. Urbain at T Troyes indicates in the master of works charged with its erection a singular boldness, and the science of a constructor s suited to astonish one. If the date of the foundation of church S. Urbain and that of the interruption of the works were not historical facts of incontestable authority, one would be tempted to assume that this edifice was erected about the beginning of the 14 th century. For ourselves, before proofs so little to be discussed, we long hesitated before believing that the 13 th century saw the commencement and completion of what exists of that monument; having the custom of trusting entirely to archaeological signs, we could not give to the construction of S. Urbain a date before the 14 th century, but a profound study of the construction caused us to see that the historical tradition was in accord with the fact. Men did not b build thus in the 14 th century. Only the architect of S. Urbain was one of those artists in whom the most advanced principles and theory are allied to profound experience, to a practice never at fault, to a sure knowledge of the properties of materials, to infinite resources in execution and natural originality; in brief, he was a man of genius. His name is unknown to us like most of those laborious artists, if Pope Urban IV sent from Italy an architec to build his church at T Troyes, we certainly should know it, but we should then not have to enlarge much on his work, for southern Italy then only erected edifices, that scarcely furnished types suited to be studied.

The play of S. Urbain of Troyes is from Champagne. The choir recalls that of the little church of Rieux, that we have just given; on the four piers of the crossing should rise a tower, probably very high, if we examine the large sections of the piers. Two other towers flank the entrance, accompanied by a projecting porch like that of S. Nicaise of Rheims. The central tower was never commenced, the nave and facade remaining unfinished. One can however by what remains of these parts render an accurate account of what this should have been. The choir and transepts are complete. Let us first cast the eyes on the plan of church S. Urbain (102), taken at the level of the ground story; this entirety is necessary to appreciate the different parts of its construction. This plan

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presents solid points of support, thick and resistant, a very simple general arrangement. Planted between two streets, two deep porches, well sheltered entrances into the two transepts. Above the ground story at the height of 10.8 ft., the entire structure presents only a glazed lantern of extreme lightness, maintained by buttresses, that alone remain solid up to the upper gutters. It is then the construction of these buttresses, that must first occupy us. Here (103) is one of the buttresses of the apse shown parallel to one of the sides. The s solid substructure 10.8 ft. high stops at A. At B′ is traced the horizontal section at the level B, and at C′ is the horizontal section at the level C. D is the glazed opening outside the gallery G. F is the free opening supporting the ceiling H and serving as a passage at the level of the sills of the great upper windows; E is the tracery of these upper windows . The archivolts of the windows tory away at I served as side arches for the great vaults. The upper gutter K is supported internally by the filling placed over the archivolts I, externally by the arch L and the entire system of tracery, w whose details we shall give immediately. The tracery D and F is partly set in rebates, so that this tracery is independent of the construction, being actual stone sashes set in the buttresses.

Let us say a word of the materials entering into this structure, for their quality is in part the cause of the system adopted. Even at Troyes, one cannot procure cut stone, the vicinity only supplies chalk, at most good for the compartments of vaults. The architect of S. Urbain of Troyes must have brought stone from Tonnerre for the cut stone parts, and to economize this material transported at great expense, he has employed so far as he could a certain stone called Burgundian, found several leagues from Troyes, which is only a very firm and coarse limestone, but in thin layers and cutting badly. With the latter material he built the massive portions of the buttresses, facing their exteriors M with great slabs of stone from Tonnerre set on edge and finely cut. Likewise with stone from Tonnerre he made these internal piers, the tracery, arches, gutters, and all the delicate parts of the construction; now the quality of the stone from Tonnerre employed here is a thin and very strong bed, very firm and compact, able to

be set on edge without danger. Indeed this construction is a structure in roughed rubble, solid but coarse, faced with a very fine and beautiful stone, used with the strictest economy, as one would do with marble today. The lightness of the tracery, andsmallness surpasses all that we know of that kind, and yet the materials employed are so well chosen, the elasticity of this structure is so complete, that very few pieces are broken. Besides the structure being perfectly stable and well weighed, the deteriorations occurring in the tracery and windows are of no importance, these being easily replaced, 1 like actual sashes, without touching the main work. The anatomy of this structure must be examined with the greatest care. We shall attempt to point out the details.

Let us then first take the entire part of the buttress comprised between H and O, i.e., the ceiling of the gallery and its lintel connecting the internal pier to the buttress, the setting of the tracery and the discharging of water at that point. At A (104) is seen the section taken through the axes of the buttress and the pier. B is the gargoyle throwing outside the water collected in the passage G, i.e., not only the rain falling vertically on the slabs, which is little, but a also that driven against the glass; C is the through channel, i.e., extended through the entire thickness of the buttress; D is the corbel relieving the lintel E, which serves as a channel that connects the internal pier H to the buttress; F is the cover of the gallery carrying the gutter. I are the two sides forming the external surfaces and maintaining the lintel channel, E, as indicated at I′ in the perspective sketch K. In this detail the block E′ is the lintel channel; C is the second channel, and B′ is the gargoyle. The larger detail L shows in place the two blocks I at I″, the channel C at C″, the covering block F at F″ with the lintel E at E″. All this masonry is made with the greatest care, the stones are well cut and set; so that no rupture is seen. Note that the channel-lintel E (detail A) is left free in its span from R to S under the blocks I; i.e., the bed R S is thick and is grouted only after the settlements of the structure have produced their effect, so as to avoid all chance of rupture. One sees at M (detail L) the grooves designed to receive the external glazed tracery of the gallery, and at N those intended to receive

the internal tracery supporting the covering piece of the tracery of the windows. How could such thin tracery both be maintained in vertical planes? The internal has a thickness of o only 8.2 ins. and the external one of 8.7 ins, including all projections. Their rigidity is obtained by the simplest means, since the arch of each between the grooves just mentioned is in one piece. Each tracery is thus merely composed of three pieces; two mullions of a flat slab pierced by openings. There should not be forgotten what we have said above of the materials employed in the construction of S. Urbain. The architect made his structure resistant with common stone, a sort of dressed rubble, and everything accessory, decorations, gutters, tracery, of stone from Tonnerre, of a low bed, very firm but of great dimensions in lengths and widths. These stones from Tonnerre are really only slabs with thicknesses varying from 7.9 to 11.8 ins., of excellent quality. The edifice is only composed of buttresses between which are set the flat perforated slabs. This singular system of construction is everywhere applied with that rigorous logic, which characterizes the architecture of the end of the 13 th century.[1]

Note 1.p.188. How is it that we, who possess cast iron today, or even that we could procure cut stone of excellent quality and in great pieces, have not thought of putting in practice the method so happily applied to the construction of church S. Urbain? What resources would not have been found in the study and use of such a true, simple system, that is so well suited to many of our edifices in which are required great openings, lightness, and that we must erect very rapidly?

Let us then take the external tracery of the galleryof the choir of S. Urbain, to examine how it is cut and set, and how it is maintained in its vertical plane. We draw it here (105) in plan at A, in external elevation at B, and in section at C. The covering stone D, making these two traceries stable, forming a gutter and the sill of the upper window, is made of one or two pieces of stone joining under the piers and drawn at F" in detail L of Fig. 104. To give more weight and rigidity to the great perforated slab forming the glazed external tracery (Fig. 105), whose section is traced at E, that slab supports a balustrade G continuing it and made of the same piece, so that the gutter D forming the ceiling of the gallery

is borne on a projection reserved inside and along the external tracery, while the lower bed of that ceiling intersects the internal tracery, likewise composed of a flat perforated slab maintained at its ends by the grooves N of our detail L of Fig. 105. It must be said, that to produce a more striking effect the architect has given to the open internal perforated tracery a more delicate design, and a form different from the external tracery, these two traceries thus produce the most brilliant perforations with a surprising play, when detached from the ground of colored glass.[1]

Note 1.p.189. This decoration that encloses the sanctuary of S. Urbain was not probably admired by all at Troyes, for s several years since, they had the idea of hiding it by an enormous decoration made of plen and pasteboard painted white. Nothing is more ridiculous than that scaffolding of pasteboard, which exposes its pretentious misery before one of the most charming conceptions of the art of the 13 th century in its decline. Barbarism that devastates is certainly more dangerous than the barbarism of the authors of the high altar of S. Urbain; but still, what would be said by the friends of art in Europe, if they saw erected a facade of carved plaster before the western facade of the court of the Louvre, under the pretext of beautifying it? How much progress have we to make yet, to no longer merit the name of barbarous, that we so freely give to times in which certainly one would never be allowed to hide a work executed with intelligence, care and talent, behind useless superfluity, coarse in material and work, without form or taste, produced by ignorance combined with the most ridiculous vanity.

Let us now see the upper part of the construction of the choir of S. Urbain, for there our architect has displayed r remarkable sagacity. If we return to Fig. 103, we shall observe that the upper windows are set vertically under the eave wall of the roof at I, that their archivolts serve at the same time as side arches and as discharging arches to support the carpentry, that the gutter K rests partly on a projection reserved above that archivolt and on tracery L placed about 1.6 ft. before the window. Here (106) at A is the external face of that tracery; at B is the section made on C D E F. On that se section is found at G the section of the window, its archivolt=

sideAarch at H and the vault at I. The tracery supporting the gutter K is composed of an arch reinforced by a gable fulfilling the functions of carpentry ties. Perforated circles L c contribute to support the gutter in its span from E to M. This gutter in each bay is only made of two pieces of stone joining at the top of the slopes at N; each of these pieces is cut as indicated at O, the span on the tracery being from E′ to M′, and the part P being cut away and without drip to allow the apex of the gable to pass. The jointing of this gable and of the open circles L is truly shown in our Fig. The cross-flower, its base intersecting the balustrade of the apex of the gable are made of a single piece of stone, so as to add a weight n necessary at the end of the jointing. But to avoid all chance of the overthrow of this gable outward, the two pieces of the balusthade R are not set in a straight line, but form a slightly obtuse angle, as indicated by the plan S; T being the base of the cross-flower and the apex of the gable, and R″R′ being the two pieces of the balustrade, each cut in a single slab; thus the apex T of the gable cannot be pushed outward, abutted as it is by the two perforated slabs R′R′ resting against the tops of the buttress pierced by gargoyles for discharging the water, as seen at V. This is rather a combination in carpentry that a masonry construction; but let us not forget that the quality of stone employed at S. Urbain lends itself to s such a structure, and that thanks to these artifices, the architect came to erect a monument of extraordinary lightness, actually composed only of rubble masonry and of perforated slabs set on edge. The flying buttresses that abut the great vaults of that church above the chapels are constructed according to this system of tracern and of large blocks of stone set like shores (Art. Arc.-Boutant, Fig. 66).

The architect of S. Urbain (his data being accepted) was f faithful to his principle in all parts of his structure. He understood that in such a light edifice, built of rubble and slabs, he must leave to these traceries great freedom to avoid ruptures; so he has only set these slabs in grooves, that allowed the masonry to settle without breaking the delicate perforated enclosures that replaced the walls. In examining Fig. 106, it is seen that the gutters are free, almost reduced to the role of spouts, and that even assuming a break, the leaks

cause no injury to the masonry, since these gutters are hung over the external void by means of those perfeorate gables. It would be necessary to be bold to conceive a structure of this kind; it would be necessary to be skilful and careful in execution, to calculate everything and to leave nothing to chance; thus this construction, in spite of its excessive lightness, of neglect and of unintelligent repairs, is still stable after 560 years of existence. The architect has required from the quarries of Tonnerre only slabs, or at most beds 11.8 ins. thick, of large dimensions it is true, but of quite small weight; thus he avoided the greatest expense at that t time, that of transportation. As for the workmanship, that is considerable; but that did not then cost most. The church S. Urbain will frequently appear in the course of this work, for it is certainly the extreme limit that stone construction can attain, and as an architectural composition it is a masterpiece.(Arts. Arc-Boutant, Balustrade, Croix, Fenetre, Gargouille, Porche, Porte, Vitraux).

It is necessary for us to return somewhat on our steps. In Ile-de-France, as we have already stated, we cannot show the boldness of the Burgundians of the beginning of the 13 th century, and of the people of Champagne of the end of that century, when they could employ large materials, hard, close-grained and resistent like the stone from Tonnerre. Tee constructors of Ile-de-France rarely made tracery from a single slab or perforated inclosures; then maintained the stability of t their edifices, less by areas or by rigid struts, than by loads accumulated at points appearing to them to not have sufficient bearing. We find a remarkable proof of this fact, after the middle of the 13 th century, in the great structures.

We have seen that the Gothic architects had come in vaulted edifices to regard the side arches as discharging arches, and to leave entirely void the construction beneath these side a arches, retaining only buttresses. They suppressed walls as being entirely useless accumulations of materials between the buttresses, since these must receive and support all the loads; but these side arches not being loaded at the crowns, could d deviate from the vertical plane, because of the pressure and the thrust of the courses of rubble of the vaults that they received. Let us state (107) tha the side arch A B C, at the

apex B of the two branches of the arch, where this pointed a arch is most flexible, receives just the last courses B D of the filling, that have a slight effect of thrust from D to B because of their curvature. The apex B might deviate from the vertical plane, if it were not rendered immovable. To erect a wall on this side arch A B C could consolidate that arch but slightly, since these two triangles of masonry A E B, C F D w would load the haunches of this arch much more than its crown B. The most certain means would be to load this crown B. Then about the middle of the 13 th century the constructors came to erect on the exterior and on the side arches of the vaults also enclosing openings, gables H I G of masonry, thus by the addition of this load B G rendering the apexes of the side a arches immovable, or at least sufficiently stable to resist the thrust on the crowns by the fillings B D of the vaults. O One of the first experiments with this system is seen at the S. chapelle of the Palace at Paris. Note that the architects of Champagne, who had adopted side arches with very grett resistauce because of their great width, since they were actual pointed tunnel vaults, receiving the fillings of the vaults; that the Burgundian architects, who isolated their side arches from the external walls by leaving between them and these walls a space wide enough to be stayed by the crowning courses, had no need to resort to the artifice explained by Fig. 107. Hence it is only rare in Ile-de-France, Beauvoisois and Picardy, that we see about 1240 adopted this means of giving stability to the side arches. Thus differences in the character of the architecture of the different provinces of France in the 13 th century are almost always explained by a necessity of construction. If one desires to take into account the utility of these gables, generally regarded ar an ornamental motive, it is necessary to examine Fig. 108.

But architecture is an imperious art; when you modify one of its members, when you add something to the arrangement, you see differences in detail accumulate. A first chauge in the system, that you at first assume to be of little importance, requires a second, then a third, then a multitude of others. Then it is necessary to recede, or to become the slave of requirements aroused by a first experiment or a concession. One contests these successive difficulties, that seem to grow as

he conquers them. In a time when idleness of mind is regarded as a virtue, men treat these perilous experiments as perverse tendencies, forgetfulness of sane doctrines. But the architects of the middle ages, and particularly of the epoch occupying us at this moment, never believed that a step backward or a repentance was an advance; they felt themselves carried onward by their own principles, and they solved courageously each of the new difficulties, that they raised without rest.

To place over the side arches triangles of stone to load t their crowns, at first sight is only a little more stone and a little more work. But gutters are needed over the side arches and balustrades on these gutters; it is necessary for these gutters to rest on the side arches and not on the fillings of the vaults; also that the slopes of these gables themselves reject the water somewhat; these rigid lines must be ornamented, it is this new member added to the architecture that finds its place without encroaching on that of the other indispensable members. Our Fig. 108 explains how the constructors of the middle of the 13 th century knew how to harmonize both purely material requirements and tose of art. Their side arch A (See section) turned and frequently doubled by the archivolt B, with the depth of the rubble filling of the vault, they s set on about two thirds of the width of these arches the solid gable C, arranging an offset of little depth at its base to receive the gutter D set on the last third of the width of these arches. The gable being removed, this gutter bore t the moulding crowning the cornice, as seen at E, and received the balustrade in a groove, according to custom. Two stones F with basins and gargoyles were arranged at the base of the gable to collect the water falling on the copings covering t these gables. These copings were cut in long pieces of stone to avoid joints according to the sketch G, and below the cornice were inserted in the tympanums behind the crockets set in grooves, with a little drip I to receive the water and conduct it into the basins of the gargoyles. Above the cornice, these copings were cut as in the sketch H, casting the water before and behind. A finial K in a single piece of stone kept in place the ends of the two inclined copings as well as the branches of the crockets. The balustrade r being set behind flush with the rear of the gable, so as to allow the passage of the

rows of crockets M inserted in the grooves. Later these gables appeared too heavy and were recessed above the very light tracery of the windows. This example illustrates how each new m member added to Gothic architecture brings a series of details, studies and combinations. perhaps some one will sayto us, that these are very great efforts for the motives that cause them; the cirticism would be just, but it strikes much higher. In the natural order, how many completed combinations do you not see, details, long and great efforts to produce apparently small results. We have not created the world nor controlled its arrangement; and if things are well arranged, it must be recognized that this arrangement is nothing less than simple. The architectsoof the middle ages will allow a criticism, that might be addressed to the great ordainer of the universe. Like their predecessors, those architects had inert matter at their command' they must have submitted themselves to the l laws of gravitation and of resistance, taking account of wind and rain. En presence of inert matter and the action of natural forces, they believed that equilibrium was the true law of construction; perhaps they were deceived; but one will at least confess, that they deceived themselves like men of genius, and there is always something good to take from men of genius, even when they are mistaken. besides, it is necessary to fully recognize, that the more man seeks, combines and complicates matters, the sooner he comes to verify the weakness of his judgment. See the rationalists (pardon me the word), artists that follow a principle true for all, conforming themselves to the most rigorous rules of logic, who take cut stone for building, i.e., a meterial formed to be used superposed in courses; in brief, the principal lines of their structures must be horizontal. No, after a half century of research, the combinations each more ingenius than the others, on the contrary they came in their edifices to cause the vertical line to dominate over the horizontal line, and that without ceasing for a single instant to follow the conseqeunces of the true principle, that they have placed. Many causes then lead them to that result. We have mentioned some of them, as for example, the utility of stones set on end to stiffen structures, the need of loading points of support drawn to leave the vertical by oblique thrusts. It is the last of these which has its

importance. In cities of the middle ages land was scarce. Every city was fortified because of the feudal system, and it c could not move the fortifications every ten years. Therefore it was necessary to place the monuments in narrow spaces, to occupy only the least possible area. Now if you build on a p principle that makes all the forces of your structure oblique, and if you cannot extend it, it is very necessary to use vertical loads instead of the area lacking. A law at first imposed by necessity, and to which one submits as such soon becomes a habit and a necessity, so much so, that even when one can free himself from it, he submits to it, it pleases him a and has become a custom. When architects of the middle ages understood, that the condition of their vaulted edifices led them to multiply the vertical loads to resist all oblique pressures, they have frankly taken their role, and since it is so necessary in an edifice for the horizontal line to dominate t the vertical line, unless they resolve to make an actual network, they came to almost entirely suppress the horizontal line, no longer retaining it except for leveling stones, to indicate an internal resting place or floor. Besides, alwayu and more consistent with their principles, the masters of works at the end of the 13 th century clearly indicated on the exteriors of their edifices the internal arrangement, and in that we should do well to imitate them. Let us examine a Gothic b building externally, and we shall say whether it is vaulted o in stone or covered by carpentry.[1] Its pinnacles will indicate to us the number of internal points of support; its bands, the tops of its vaults, the strength of its buttresses, the energy of the thrusts and their direction; its windows, the number of the side arches of the bays; the form of the roofs, the perimeter of the different halls, etc.

Note 1.p.197. In this respect, and to demonstrate to what extent opinions on architecture are false today, we shall cite the judgment of a very intelligent man, who seeing external buttresses indicated in a project, claimed to have them omitted by the architect, giving as a reason, that the progress of construction must cause the omission of these appendages applied to edifices.in barbaric times, and that indicate nothing but ignorance, etc. As much as to say, that we are too civilized to be true, and that a deception is the surest mark of

progress.

Already at S. Urbain of Troyes, the different members of t the construction are so delocate, they each possess a function so clear and independent, that the architect assembles them, but does not tie them together, he places them beside each other, holds them together by mortises and overlays like joinery; but he avoids tying them together, for this produces homogeneity of all parts, and the constructor fears that in the use of a system in which every part of the structure acts, r resists, possesses its own force or its own resistance, force and resistance that can only be effecient, when they are independent. At the beginniug of the 14 th century, this system of leaving to each member of French constructions its proper function, and of connecting these members because of the particular function of each one, is pushed even to exaggeration of the principle. That is very apparent in a very interesting m monument erected from 1320 to 1330; we desire to speak of the choir of church S. Nazaire of Carcassonne, one of the rare o original conceptions of that epoch during which the art of ar-architecture already fell into the application of formulas, and left aside all new attempts and individual expression.

Careful examination and the analysis of this monument have revealed to us a fact interesting to us today' this is the simple method pursued by the architect and his subordinates in erecting a structure very complicated in appearance, and that seems to require a fabulous quantity of operations and drawings. In reality the difficulties in the masonry do not exist. This structure is only an assemblage of vertical planes whose revolved positions only require a single drawing. It must indeed be admitted before all else, that the architect knows what he wants, that he sees his edifice in all its aspects before commencing the foundations, that he has taken into account the different parts of his structure; that he has done the work before the cutting of a stone, that we do in an edifice when we measure and examine it in its least details. Gothic architecture is over particular on that point, and perhaps this is why it has made so many enemies. It is consoling to say, when a difficulty occurs in the work; "We will see to that in the finishing." It is so painful, when all is not foressen in advance, to hear daily a long series of questions presented by

the stonecutter or the foreman; questions that must be answered clearly and simply, like a man that knows what he is going to say, as it he had foreseen what would be asked him! Then the architect of the choir of S. Nazaire of Carcassonne not only made the plan of his eidifce, not only the elevations a and sections, but he knew in advance the exact points of the imposts of the different arches, their meeting and intersection; he knew the results of the thrusts, their direction and force; he had caluclated the loads and reduced the forces and resistances to their most proper limits. He knew all in advance that it was nemessary for him to know, from the first course laid above ground. His conception being thus complete, fixed on paper, and in his head, his subordinates proceeded blindly. He said to one, "Here is the drawing of the pier A, which is repeated twice; here is the drawing of the window A, that is repeated six times; here is the drawing of the buttress C, that is repeated ten times, etc., that of the window B to be repeated seven times; here is one branch of the pointed arch with its imposts, of the transverse arch with its imposts, etc." That being said, the architect can go away and allow the cutting of all the pieces of each member. The cutting finished, a master setter them comes, who without possible error, hoists and assembles all these different pieces, n necessarily all taking their places like the parts of a well conceived machine. That method of procedure explains how at that epoch (at the end of the 13 th century and in the 14 th), French architects caused the erection of monuments in countries in which perhaps they had never set foot, how men demanded in Spain, southern France, Hungary, Bohemia, projects of monuments from those architects, and how those monuments could be erected and recall accurately, except some details of mouldings and sculpture, the edifices built between the Somme and the Loire. The choir of church S. Nazaire of Carcassonne was probably erected thus, by the aid of drawings furnished by an architect of the North, who perhaps scarcely sojourned in the city; what makes us believe this is, that evidently the architect avoided all difficulty requiring a decision at the place, those difficulties not solved by a drawing, but by explanations given to the stonecutters and to the workmen themselves on the yard, following their work by the eyes, taking

up at need the guage, rule, square, laying them on the drawing. For example, the architect in the vaults of that edifice has almost entirely rejected imposts common to several arches; he has given the curve of section of each; they have been cut w without considering the adjoining arch, and the master setter has come to arrange all that like a game of patience. But to make appreciated the sengular method of construction employed in the choir of church S. Nazaire of Carcassonne, it is useful to give half the plan of that choir with its transept.(109). We see in that plan the horizontal projection of the vaults; they all have their crowns at the same level or nearly so, a although their dimensions and forms may be unlike; necessarily the imposts of these vaults will then find themselves at very different levels. It is necessary to see the general s section of this construction on A B. The architect thought o of closing the vaults C (110) at a level below the great vaults of the sanctuary and transept; the construction had even been erected thus as far as above the springings of these low vaults, as shown by the dotted lines D E, but the architect had to yield to the desire to produce more effect by raising the crowns of all the vaults to the same level. Perhaps the requirement of the clergy caused the adoption of this last mo-mode; what is certain is that the low springings indicated by dotted lines were cut on the faces of the piers, ar easily r recognized, and that these springings were raised as our drawing indicates, so as to have on the entire exterior of the e edifice windows of equal height. Fig. 111 presents the section on line G H of the plan. Let us state at once, that to prevent the bending of such thin piers pushed by unequal thrusts, produced by raising the secondary vaults, the architect has placed ties I of iron 2 ins. square, visible in both our sections; that the stone employed is a hard and very resistant sandstone, that permits placing the vaults on slender points of support. Let us now examine with care the details of that construction, take the head of the pier K (of the plan) at t the point where that pier receives a great intermediate arch of the sanctuary, two archivolts, a transverse arch of the c chapel and two branches of the diagonal arches. The horizontal section of that pier (112) is traced at A. From B to C we see four courses of impost blocks that receive that great transv-

transverse arch. From the joint C normal to the curve of the transverse arch E, the voussoirs of that arch are independent; the fier rises behind the filling F if that arch without ties to it, as far as to the side arch G. The projection of that capital forms a bond with the filling, and then the pier is i independent up to its meeting with the side arch H. Above the capital G the filling rises vertically from I to K. It is perforated by the trefoil L, which decorates this bare triangle and receives the filling of cut rubble. The two iron bars M serve as ties between this pier and the next; they resist the thrust of the transverse arch E.

Let us take the next pier L of the plan, that of the reentrant angle, which finds itself between three mullions, and re receives a great transverse arch, two great branches of diagonal arches of the principal vaults, and a third branch of t the diagonal arch of the chapel (113). One here sees that the trace of each of these three parts is made independent of the others, and that the masonry only presents the fewest connections possible, to avoid too complicated drawings. This independence of the different members of the vaults springing from the piers leaves great elasticity to the construction, an elasticity necessary in so light a monument, very high and unequally loaded. One indeed can find in the choir of church S. Nazaire torsionsand considerable movements, without the building losing anything of its stability. Again, these are not examples to follow, but very useful to know, because of the s simple and practical means employed. Let us see the external side of the same pier. (114).

We are placed in the angle of the chapel at the point V of the plan; we assume the upper part of the tracery of the great window of that chapel to be removed.[1] One sees at A the bar of iron that maintains the heads of the little columns of that tracery, and that at the same time serves as a tie at t the springing of the arches (Art. Meneaux); at B is the groove reserved for setting the curved open part of the tracery; at C′ are the imposts of the side arch that receives the perforated stone tracery; at E is the branch of the diagonal arch of the vault of the chapel, whose two impost courses are combined with those of the side arch. Above the joint D, the voussoirs of this diagonal arch are independent. At G is the arch-

archivolt enclosing the round and perforated arch of the first window of the sanctuary and taking the place of the side arch of the vault in the interior; at F is the archivolt-side-arch of the tracery not glazed and separating the chapel from the choir. Here one will note the reentrant angle behind the diagonal arch E; this proves in the most evident manner that each member of the construction was drawn and cut separately on t the yard after partial sketches, and that these different parts thus prepared by the stonecutter were placed by the stone setter, who alone knew each of their functions and their relation in the entirety of the structure. The mason came to fill the intervals remaining between these members confused together and intersecting, while remaining entirely free. We have traced at K the horizontal projection of this reentrant angle with the intersection of the two archivolts-side-arches G.

Note 1.p.204. This operation having been done under our eyes, we have been able to recognize very accurately and reproduce here this construction.

Such a construction is only composed of piers receiving elastic and resistant ribs, supporting the fillings of the vaults, or maintaining the stone sashes in the wide grooves; it makes us know that the master of the work could abandon nothing to chance, could postpone nothing, foresee all from the first course, arrange his drawings systematically, and that after the stone was cut according to these drawings and the blocks were ready, he only needed to give instructions to a skilful setter, who successively took all parts of the edifice and placed them in their order, as the carpenter's laborer takes one by one the timbers of the carpentry framed in advance to the site to place them for raising. Today we proceed otherwise; blocks of stone are collected often without knowing the definite form that they will assume, and on these blocks are cut the intersections of the imposts and the mouldings, as one would do in a homogeneous mass, without caring much f for the beds and joints, that do not coincide with the forms given. Is this better? Is this the means of obtaining more stable structures? It is permitted to doubt it. Yet one can state that it is less reasonable, less skilful, less intelligent and more costly.

There is no religious structure of the middle ages more ad-

advanced than that of church S. Urbain of Troyes and S. Nazaire of Carcassonne in the path opened by the architects of t the 13 th century. Indeed one could not go beyond it without substituting metal for stone. Either the architects of the 14 th century were arrested by the impossibility, or unlucky attempts proved to them, that they had already passed the limits imposed by the material, there was always a reaction about 1330, and the constructors abandoned these too bold methods to return to a wiser system; but this reaction had as an effect the destruction of originality; men came to formulas. At that epoch we see the architects leave aside in the live works of their structures, the simultaneous assemblage of stones on their beds and their edges, which furnished the constructors of the 13 th century sucr beautiful motives of architecture; they retained the forms imposed by this system, but no l longer appreciated the reasons for them; losing something of the adventurous spirit of their predecessors, they renounced stones on edge for points of support and means of rigidity, and returned to structures built in courses, reserving stones set on edge for tracery, facing arcades, i.e., for architectural members in carrying a load, and merely sashes oh decorations. Yet as if to follow, at least in appearance, the consequences of the system of construction adopted in the 13 th century, they multiplied vertical liner, they desired that in only the members of the vaults, the arches, should each have their point of support, but even the mouldings by which these arches are decorated. Therefore it results between the form given to the piers, for example, of the construction of these piers, there is the most evident contradiction. In fact the constructors of the 14 th century returned to heavier forms, although they strove to disguise this reaction under an appearance of lightness by multiplying the small architectural members. As practicians, they are very skilful, very prudent, full of experience and adroit; but they entirely lack invention; they have no longer the boldnesses denoting genius; they are wiser than their predecessors of the 12 th century, but they have the defects which frequently accompany sagacity, their safe methods and formulas are impressed by a fatiguing monotony, in spite of all their efforts.

The most striking and one of the most complete example of

the religious construction of the 14 th century is the cathedral of Narbonne, whose choir only was built from 1370 to 1400.[1] This is the work of a consummate master in his art, but without that imagination and those unexpected resources, which charm in the structures of the 13 th century, and that lend themselves to the most varied conceptions. What gives the degree of practical skill to which the architects of the 14 th century had attained was the renewal of the lower work, those partial reconstructions made in the oldest edifices. At that epoch the materials employed are always of the first quality, the drawing is wise and the construction excellent, the cutting executed with remarkable care. Besides the general system of construction is modified very little, it is applied with more certaintn and with a perfect knowledge of passive and active forces, of loads and thrusts. For example, the flying buttresses are well drawn and are set exactly as they should be. We have a very evident proof of this at the cathedral of Paris. All the flying buttresses of the nave were rebuilt at that epoch (about 1330), and rebuilt in such a manner as to be above the galleries of the second story, and to spring from the great external buttresses.(Arts. Arc-Boutant, Fig. 59; Cathedrale). These flying buttresses, which have a very long radius and consequently a very flat curvature, were calculated with an exact knowledge of the function that they had to fulfil, and when one thinks that they must have been rebuilt in novel conditions, supporting old constructions, one is compelled to recognize in these constructors of the 14 th century a great experience and uncommon skill. We do not believe that it will be necessary for us to enlarge further on the religious structures of the middle ages, for we shall teach nothing new to our readers after what we have already stated. The Articles of the Dictionary will further exhibit the differences resulting from the perfecting of details introduced by the architects of the 14 th and 15 th centuries in religious structures. We shall now occupy ourselves with civil and military buildings, that proceed after their particular methods, having but little relation to structures purely religious.

Note 1.p.201. It is necessary to state, that we do not have in France a single great and complete edifice of the religious architecture of the 14 th century. The 13 th century left

in great monuments of that kind to be built. The 14 th century could only complete edifices already commenced, that had no leisure to finish the small number that it founded.

CONSTRUCTIONS CIVILES. Civil or secular Structures.

About the first times of the middle ages, Roman traditions were perpetuated on the soil of Gaul in civil structures as well as in military works; yet wood then played a more important part than in the Gallo-Roman period. The Gallo-Roman system of construction does not differ from the Roman system; t the same procedures are employed, ruder in regard to execution. During the Merovingian period, one recognizes a very frequent use of wood, not only for coverings but in ceilings, w wainscotings, porticos, and even the walls of habitations. Germany and Gaul produced wood for carpentry in profusion, a and that material being easy to use, it was natural to use it in preference to stone and brick, that require difficult quarrying, cutting, hard transportation, or a previous burning a and time.[1]

Note 1.p.208. It was scarcely until the end of the 13 th c century that the forests of Gaul began to lose extent and quantity, i.e., at the moment when the feudal organization decreased. During the 14 th century many feudal lords were obliged to alienate in part their properties, and the monastic establishments, chapters or communes cleared a notable section of the forests of which they had become possessors. At the time of the wars of the 14 th and 15 th centuries, the forests in many localities being no longer subject to conservation and control of the feudal system were cruelly devastated. Those that existed on the mountains were thus forever lost, because of the removal of the earth on the steep slopes. Thus the South and the entire centre of present France were despoiled of the forests, that covered the plateaus, and whose existence was still proved about the end of the 13 th century.

The fires that destroyed such a great number of cities and market towns during the 9 th, 10 th and 11 th centuries, contributed to cause the abandonment of wood in construction of private buildings as in the construction of churches. Men no longer used this material, except for floors, roofs and internal partitions of habitations. Already in the 12 th centurw, a number of cities presented facades of houses in cut stone

or rubble, except in certain areas without ouarries, for example as in Champagne and Picardy.

The monastic establishments, so rich in the 12 th century, gave the example of civil structures in stone, and that example was followed by private persons. It must be stated to the honor of the constrscutors of that epoch, that in adopting cut stone or rubble in place of wood, they very probably took a mode of construction appropriate to those materials, and did not seek in their use to reproduce the forms or arrangements suited to wood in carpentry. Always disposed to preserve to the material placed in the work its real function and the appearance suited to it, they did not attempt to disguise the nature of the material. Further, the means employed were extremely simple, and those artists that exhibited a singular subtlety in their religious structures after the 12 th century, a search for such complicated means, contented themselves in civil buildings with the most natural and least labored methods. Economies in materials that theu comparatively cost more than today, during the 12 th and 13 th centuries, their houses are reduced to the essentials, without pretending to seem more or other than they are, i.e., walls pierced by openings, supporting floors composed of beams and visible joists, well sheltered next the street and the court by projecting roofs, that cast the water far from the walls. Very rarely, except i in some cities of the South and Centre, the ground story was vaulted; consequently no buttresses or projections on the exterior. Most frequently walls of visible dressed rubble with some bands, jambs and lintels of doorways and windows in cut stone; also these lintels and jambs did not extend through b but only faced the exterior; the bands alone connected the t two internal and external faces of the walls.

To give an idea if these civil structures most common in t the 12 th and beginning of the 13 th centuries, of the simplicity of the means employed, we select from a very great number of examples one of the houses of the city of Cluny, so r rich in houses of the middle ages. Here (115) is the face of the external wall of this house on the street. One sees that the construction only consists of rubble masonry with some c cut stone for the bands, arches, windows and their lintels. The lower arches open into the shops. At the right of the door

to the alley leading to the stairs. The second story presents an open gallery composed of piers and little columns and lighting the great hall. The openings are rectangular and receive casement sashes. In the lintels and under the internal arches supporting the wall of the third story are pierced little transom windows. The third story is lighted by a gallery of less importance, and a strongly projecting roof casts the water far from the surface. In plan the second story gives Fig. 116, a and Fig. 117 reproduces the frontseen from the interior, with its discharging arches above the lintels of the second story, the benches of the windows, and the span of the beams supporting the joists. These principal beams, set against the face of the wall between the arches connected the two parallel walls of the house and served as ties; they were relieved in s span by wooden corbels, as shown by the section (118). (Art. Maison). There is the simplest expression of private architecture during the middle ages; but the civil structures did not always have such a frank character. In the great habitations aud castles the services were much more complex, the anhabitants very numerous, and it was necessary to find internal arrangements and lobbies. Yet there were certain general arrangements, which remained the same for the nobleman's habitation as for that of the citizen. It was always essential to have a hall, the place for the gathering of the family of the citizen, of the household of the lord;[1] then the chambers with their wardrobes and closets; lobbies to react these rooms with private stairs; thus there were under the same roof very large rooms and others very small, passages, air and light everywhere. One frequently assumes quite erroneously, that the habitations of the lords, as well as of the petty citizens of the middle ages, could only be dark and gloomy, badly lighted and poorly ventilated, that as again one of those absolute judgments, that should not be applied to that epoch. Unless arrangements for defense obliged the lords to open only very few windows, on the contrary they sought in their castles light and air, a view of the country, and different orientations so as to have everywhere sunshine or coolness at w will. However little men take the trouble to think, they will indeed understand, that men who passed the greater part of th their lives in traveling over the country, could not with good

ill shut themselves in, sometimes for entire weeks, gloomy hambers without outlook, air and light. If the defensive arangements of a residence compllled the occupants to open the ewest possible windows on the exterior, if the courts of the astle surrounded by high buildings were frequently gloomy a nd dark, yet the inhabitants sought by all sorts of ingenios means to obtain for themselves views over the countrw, air nd sunshine. Hence these little flanking turrets, those watn turrets, corbellings, square recesses that permitted opening windows masked from the exterior. Very sensible customs lso imposed on the architects particular arraugements in the reat habitations. Men did not admit during the middle ages, o more thau in antiquity, that a great hall and a little chmber should have the same height between floors, that a corridor should be as high as the rooms that it served. There ha ave been necessary centuries of false reasoning in architecure to forget such true principles, and to compel us to live n great halls with low ceilings, if the story that we occupy s low, or in little cabinets of excessive height, if we have story 13.0 or 16.4 ft. between floors. For the great cities he stories being necessarily fixed, one again understands t hat necessity has imposed arrangements as inconvenient as r idiculous; but where the architect is free in a pleasure hose or chateau, it is unreasonable to not take into account he dimensions and areas of the rooms and not fix the height roper for each one, to light cabinets or corridors by windws having the same dimensions as those opened into great r ooms, to cause lateral corridors to obstruct all windows on ne face of the building, the landings of stairways to cut a cross windows at half their height, mezzanines taken at the xpense of the great windows, to not disturb a certain order f architecture, that is of little importanci to the occupans of a palace; or indeed also to establish, in the midst of ouble buildings corridors serving the rooms at right and left, lighted by borrowed light, badly ventilated, dark, noisy ike the corridors of inns, losing precious space and loading he floors in their weakest parts.

The architects of the middle ages did nothing at all of all hat, and did not even think it possible; we should not blame hem for that. Their buildings for residence were nearly all

single in depth, and so that the rooms cut off transversely should not be passed through, which would have been very inconvenient in many cases, they established along the buildings closed and low galleries, that served each room, also allowing windows to be opened over them. Example. (119).

Note 1.p.211. This household comprised not only the family, but the servants, men and women at wages and the entire personnel of the castle.

If the building had several stories, this arrangement could be retained with all its advantages. (120). One sees at A the second story with its service gallery C, over which open the windows lighting the halls; at B is the upper story. Almost always ceiled, lighted by windows with dormers at the side o opposite the gallery, and by dormers alone above that gallery. The corridor of the upper story is supported on arches, that allow between their piers the opening of windows lighting directly the second story. An arrangement of this kind still exists at the palace of justice of Paris, in the western part; it dates from the 13 th century. One cannot disdain what is r reasonable and true in such a construction, that gives to each service its relative importance, which leaves to the principal rooms all the air and light which they need, and that v very frankly emphasizes on the exterior the services and the internal arrangement of the building. That is certainly more according to good antique traditions, which is not a series of columns or pilasters stuck against a wall, nobody knows w why. This is indeed the religious architecture of the middle ages, that varies from antique forms, but long knew how to re retain the spirit in civil architecture. We shall furnish another proof of it.

When habitations are vast and the buildings consist of several stories, which the architects of the middle ages did not condemn, for the simple reason that two stories over each other cost less to build, than if a ground story covered an area equal to the two stories, sence it is then necessary to double the foundations and roofs, we say that if the building contained several stories, the architect multiplied the stories so that each apartment might have its own. Yet there was always a principal stairway of honor, that led to the rooms intended for receptions. During the Romanesque period, steps of

cut stone were very rare, they were most frequently made of wood, i.e., by superposing short blocks of squared timbers, logs of wood entering somewhat into the side walls. Then the stairs were composed of two straight flights with landings, and they were enclosed in a rectangular stair hall divided lengthwise by a wall.(Art. Escalier). This method was almost entirely abandoned by the constructors of the 13 th century, who adopted screw stairs with newel and steps of stone, as o occupying less space and more conveniently serving the different stories necessary to be reached. If these screw stairs we-were of very small diameter, i.e., of 5 ft. inside, they were often sunk into the thickne s of a wall forming a slight projectioy externally rather than internally; on the contrary if they occupied a cylindrical or polygonal hall of quite large diameter inside(8 or 10 ft.), they entirely formed an external projection and did not interfere with the internal arrangements. As for detached buildings, each had its particular roof, and if the buildings were double in depth, there was a roof on each one with intermediate gutter. The architects of the middle ages having believed it necessary to adopt roofs with slopes above 45° degrees, and not knowing curb or mansard roo roofs, could not comprehend a building of double depth under a single roof, for this roof would have reached an enormous height. Each detached building or pavilion, each stairway having its special roof, either pyramidal or shed, or in two slopes with gables or hips, it was easy at need to place these roofs at different levels, thus obtaining high rooms between the floors when they were large, or low when they were small. This method required much wood, and a very extended area of covering, demanded lead gutters inside; but it had the advantage over that consisting in enclosing all the services of a building beneath the same roof, of furnishing the architects varied resources in heights to be given to rooms, permitting them to open a great number of dormers to light the upper rooms, to leave vacant the tops of the stairways, which thus served as watch turrets above the roofs and procured ventilation for the lower stories. As for appearance, these separate roofs covering grouped separate structures, emphasizing their form and purpose, were very picturesque and gave to great habitations the appearance of a collection of houses more or less high,

more or less extensive by reason of the services that they c contained. One will conceive that this differed in all points from our modern structures, and it must be stated that these traditions were retained until about the middle of the 16 th century. As a principle if not in form, one finds in these a arrangements the traces of the grea antique habitations, the villas, that indeed were only groups of buildings more or less well arranged, but distinct in their form, height and covering. Very little subject to the laws of symmetry, the architects of the middle ages also placed the different services of the great habitations, after the orientation, according to the needs of the occupants and conforming to the form of the site. There was a point of resemblance to the antique villas, which in t their entirety had nothing of symmetry. In the towns, then nearly all fortified, ground was scarce as in all enclosed c cities. In the castles, whose perimeter it was always sought to restrict as much by motives of economy, as for the power of defending them with a less numerous garrison, space was economized. Thus it was necessary for the architects to seek in the city as in the country, te enclose as many services as possible within an area of relatively small extent. In this respect the civil structures of the middle ages differ from t those of the ancients, the latter in their villas rarely built more than one story and occupied great areas. Compelled to k keep themselves within limited areas, the constructors of the middle ages saw themselves constrained also to take internal arrangements different from those adopted by the Romans, to superpose services, to find lobbies in the thickness of the walls; consequently to seek entirely novel combinations of structures. Yet do not forget this important point, viz:- that antique traditions were perpetuated in civil structures by t the very natural reason that everything connected with daily life is transmitted from generation to generation without possible interruption, that habits in interiors cannot be abruptly modified, and that if it be possible to make a radical revolution in the system of construction of public monuments, l like churches, it becomes impossible for the houses and palaces that men inhabit, and in which each one has adopted the habit of living just as his father lived.

The system of construction applied at the end of the 12 th

century to religious edifices had only a weak influence in c civil edifices. The pointed arch with its so extensive consequences, as we have shown, scarcely appeared in the latter ed edifices. Civil and military construction retains something of Roman art, when already the last traces of that art have b been abandoned long since in religious architecture. Dating from the end of the 12 th century, there were then two very distinct modes of building; the religious mode and the civil mode; and that state of things exists until about the middle of the 16 th century. The monasteries even adopted one or the other of these modes; buildings for habitation have no relation as a system of constrsction to the churches and chapels. Yet one of the principal qualities of construction at the moment when it abandoned Romanesque traditions, boldness, is a also found in civil as well as religious architecture, but in civil architecture it is evident that positiv ideas, daily needs and transmitted habits, have a more direct influence on the methods adopted by the constructor. Thus for example, constructions in rubble and concrete are long found in civil arcnotecture, after all religious structures were erected in c cut stone; stone lintels were everywhere employed in the habitations of the 12 th, 13 th, 14 th and 15 th centuries, when one no longer finds a trace of them in the churches. The buttresses, even when vaulted stories exist, are avoided as much as possible on the exteriors of palaces and houses, while they alone form the entire system of construction of churches. Wood does not cease to be employed by civil architects, while it is no longer reserved exclusively except for roofs of cathedrals and of all religious monuments of some importance. Finally, a architects seek to avoid solid parts, to diminish the points of support, come to suppress entirely the walls in erecting t their great religious structures; while in civil architecture, they increase the thickness of the walls as the customs of c comfort penetrate everywhere, and men hold to having the habitations better enclosed, safer and more sanitary. The study of these two modes of building must then be pursued separately, and if we find inevitable relations between these two systems, this is less in the practical means than in that frank and bold charm, those infinite resources, which belong to the lay architects of the middle ages.

All persons with some notion of architecture know that the Romans, even when constructing vaulted edifices, resisted the thrusts of vaults rather by internal buttresses than by piers forming external projections. Particularly in erecting civil buildings, they had adopted the system of construction that we term cellular, i.e., they composed these buildings of a series of halls with tunnel vaults on division walls reciprocally a abutting each other, and exerting no thrust externally. From this principle, sufficiently explained by Fig. 121, resulted the natural consequences. For example, if one desired all these abutting cells to form only a single hall, it sufficed to have a tunnel vault intersect all these transverse tunnel vaults; thus were obtained a series of cross vaults (122), well abutted by the internal buttresses A, the remains of the division walls B, indicated in purpose in Fig. 121. This arrangement permitted the erection at C of solid walls, or of open walls as light as possible, since nothing loaded them. This was a very simple structure, very durable and easy to erect, that long served as a type for the civil edifices of the Carlovingian epoch.

To avoid expense, and if one did not absolutely require vaults, they were contented during the Romanesque period to place the floors on two parallel rows of round arches. By this means one could erect several stories over each other, without fearing to see the side walls overthrown, since they w were composed of buttresses giving a series of piers in the interior connected by the arches that stayed them; beneath these arches were made openings as large as required to give air and light to the halls. Figs. 115, 116, 117 and 118, which present to us one of the houses built in the 13 th century in the city of Cluny, still retain the remains of this Roman tradition, for the front wall of this house is actually composed only of a series of dischargind arches masked behind the external surface. If this combi ation lent itself to the most ordinary civil structures, it was equally favorable to military conditions, as we shall soon see, it was applied very late a again in the construction of the great halls of castles and of bishops' palaces, since the hall of Henrw II at Fontainebleau shows us one of the last examples, when before was seen a hall of the 13 th century in the eiclosure of the castle of

Montargis, and that one yet sees at Angers near the cathedral, the old hall of the synod of the 12 th century, both erected according to the same principle. (Art. Salle).

What is very important to note in the civil structures of the middle ages, is the care with which the constructors foresaw even the least details of the structure. If they had to insert a floor, they left properly spaced holes for the beams in the internal surfaces of the walls, and did not cut them afterwards; they set stone corbels under the spans of these beams, they left horizontal grooves along the division walls to receive the plates into which were framed the joists, or holes regularly spaced for their ends. In the splays of openings, they set the hinges while building, and they arranged p projections at the inside of mullions to receive the staples of bolts or bars. Their fireplaces were built at the same time as the walls and had the flues cut inside with the greatest care; the jambs of the fireplaces are bonded to the walls and not merely set against them; the passage of the flues through the floors, the supports of the upper hearths indicate an extreme foresight, arrangements studied before execution. All these things would be for us today excellent instructions, if we were willing to see and to free ourselves from that mania of believing tha we cannot take anything good from the past, when that past is on this side of the mountains. In great civil structures, such as halls of assembly, and the markets, the constructors of the middle ages almost always have taken care to make lower the upper window openings, the lower windows allowed the sight of what passed outside, and of admitting air, the upper windows sent the light direct from the sky. T These elevated openings are made in the height of the roof a and form dormers externally. However extensive the halls were in area and height, the windows a e always found proportioned to the human height, and what is more important, to the reasonable dimension that one can give to a wooden sash destined to be opened frequently. As for the sashes of the dormers, t they opened like skylights by means of pullies and cords.(Art- Lucarne).[1]

Note 1.p.221. Dormers with stone fronts were placed on buildings of the 13 th century, the skill under Louis XIV it was claimed that this mode of making openings at the base of roofs

oofs was invented by Mansard, to consecrate the memory of t
his useful invention, there has since been given to these o
penings the name of mansards (?), as if all the civil build-
ngs, chateaus and houses were not provided with mansards un-
er Francis I, Louis XIII, and much before them. But such is
he weakness of the 17 th century, that claimed to havi inven-
ed everything. Now this is only a pretension. It is with th-
t as with many other things at that epoch. It has been writ-
en and repeated many times, that the wheelbarrow, for example,
as invented in the 17 th century, when the great works of t
erracing were undertaken at Versailles, we have numerous cop-
es of wheelbarrows represented on the manuscripts and stain-
d glass of the 13 th century. It is true that the forms of
hese little vehicles at that time is much more convenient f
or the laborer, that that adopted after the 13 th century, a
nd which we religiously reproduce in our yards, as if there
as a masterpiece. It is the same with the dray, said to have
een invented by Pascal.

One is too much induced to believe that during the middle
ges, however ingenious were the architects, they did not know
ow to conceive those broad arrangements of the entirety, th-
se vast structures of the civil kind demanded by our modern
eeds, taking more importance daily, that is again a prejudice.
t must be said, that most of our great churches still stand-
ng today, cause us to see very well, that in religious archi-
ecture the constructors knew how to undertake and complete
ery vast monuments; but for the civil buildings of the midd-
e ages, changed during the last centuries, condemned to sys-
ematic destruction since the revolution, scorned by our Fre-
ch city governments, who give themselves the weakness of Lou-
s XIV at a little scale, and desire all in their city to re-
all their existence, for our civil buildings of old date, let
s say that the have become very rare, and it is not surpris-
ng that the people have lost even memory of them. Still it
ould have been very strange if men capable of conceiving and
xecuting such vast religious edifices would be contented for
he ordinary needs of life with little buildings of small ex-
ent, low height and narrow, a sort of huts of mean appearan-
e. There are certain persons that would make us believe, be-
ause of the spirit of a system, that we do not have to crit-

criticize here, because it is entirely foreign to the ideas of art, that the society of the middle ages was restricted to the church and the fortress5 that it was consequently unable to conceive and execute those great establishments of public utility demanded by our modern customs; finally that it lived miserably, suppressed by a twofold oppression, often rivals, but always united to arrest its development. From the political point of view, the fact can be discussed, but it is not our affair, yet from the point of view of art, it cannot be sustained. The artists that drew the plans of our cathedrals were not embarrassed, when required to construct those great civil establishments, such as hospitals, colleges, city halls, markets, farm buildings amply provided with all their services. As architects it is of little importance to know w whether these hospitals, colleges, farm buildings belonged to abbeys or chapters, if those city halls were frequently closed by the nobles, if those markets paid a tax to the lord of the place. Those establishments existed, and that is all we need to prove; they were well arranged, well built in a durable a and wise manner, which is all that is necessary to recognize.[1]

Note 1.p.222. One can understand the spirit of passion that caused the destruction of castles and even of churches; but what is more difficult to explain is the blind mania, that has caused the demolition in France during sixty years of such a quantity of very good civil buildings, very beautiful and useful, merely because they were old, that they recalled another age, to replace them by deplorable structures, and that cost dear although build with parsimony, and that were often vern ugly. Many cities were thus deprived of establishments, that could have satisfied new needs, which attracted notice of travelers, and which on the whole did them honor.

Let us take some examples; let us examine the beautiful arrangements of the great halls of the abbeys of Ourscamp, S. Jean-des-Vignes of Soissons, Mont-S.Michel-en-mer, of the hospitals of Angers,[1] Chartres, which date from the end of the 12 th and beginning of the 13 th centuries. Where shall we f find better constructions, better conceived, grander, more s sanitary, yet without luxury, and that give a higher idea of the knowledge and the practical sense of the architects? The entirety and the details of some of these vast buildings being

engraved with minute care in the work of M. Verdier on civil architecture, we do not believe it necessary to reproduce them here; we shall give our readers some structures, that have not yet been studied, and that have an importance at least e equal to those. There exists in the abbey of S. Marie of Breteuil a vast building flanked by four turrets with battlements, which could at need be defended. Its ground story contained the kitchens and their dependances. The second story contained the dormitories of the guests of the monastery; the third the great infirmary; the fourth the storerooms of provisions, and the fifth beneath the roof was a granary for grain. A lateral stairway passing through buttresses and covered by a shed roof extended to the third story, the angle turrets also had screw stairs communicating from one story to another. This building was vaulted only in the ground story and under the roofs; it was divided lengthwise by a row of piers. Lateral buttresses opposed the thrust of the vaults. Here (123) is the appearance of that building externally.[2] We see the gable against which is the great fireplace of the kitchen. A triangular buttress strengthens this gable wall at the chimney flue. To properly seize this construction, it is necessary to refer to the plan (123 bis) taken at the level of the ground story. The entire space A A, i.e., the last bay of the hall, is occupied by the fireplace, whose flue rises between two arches at B. At C are the external openings communicating by a splayed hole with the air inlets D designed to act vigorously on the fire placed on raised grates, and to establish a current of a air sufficient to carry the smoke into the central flue. Fig. 123 ter, made on the line I K of the plan indicates to us at B the chimney flue, at C being the dotted openings, and at D the blow holes. One will note that the passage along the battlements is not interrupted by the turrets and gables, but on the contrary this passage remains at a lower level at the gables. Fig. 123 quater indicates at A the section of the ground story on the line E F of the plan, and at B this section on the line G H. In section A are seen at C the arches that form the mantle of the fireplace divided by the great pier, at D are the mantles of the blow holes with the raised grates. In section B the arches M that form the vault of the fireplace are of brick, and the flue is dotted at O. A dotted line like-

likewise indicates the two air inlets P intended to supply th the blow holes by the opening behind the partition wall forming the back of the chimney. The section (124) made across t the building and looking toward the gable opposite the fireplace, completes this beautiful and simple structure. There is seen at A the lateral stairway ascending to the third story through the buttresses, increased by a projection to allow it to pass. The windows B of the fourth story serving as a s storehouse are pierced in the gable at the level of the internal floor, so as to facilitate the hoisting of stored articles by pullies and external cranes. It is the same with the d doorways C opened at the level of the fourth floor of the granary. The side walls are thick and maintain a uniform temperature in the interior, the ventilation of the stories can readily occur by means of windows opened in the four sides of the building isolated from all parts. The buttresses stiffening the walls avoided all transverse tieing, and that so m much the better as the internal faces of the walls were set to overhangin each story as indicated by the horizontal section, Fig. 124. That was a means frequently employed to cause the walls to incline toward each other inside, and it is indeed an excellent principle of construction, when one can give the base of the walls a sufficient thickness to not fear bending. Further it is necessary to remark, that usually the intermediate floors do not connect the eave walls (see cross section); for observe how the spans of these floors are arranged on the intermediate walls. At each story the piers have a cap A (125), projecting only under the beams. Then it was necessary for these eave walls to press against these beams and not produce tension. One cannot adopt that method in structures, but it is not without its advantages, and much before the epoch occupying us, the Greeks of antiquity had followed it in ericting their temples. If in great vaulted structures borne on isolated piers, the architects of the middle ages followed the laws of equilibrium, whose importance we have tried to m make appreciated, they at the same time sought to obtain concentration, the combination of all active forces at the centre of their edifices, so that all parts might have a certain tendency to reciprocally abut each other. In civil structures, where vaults only play a secondary part, where the floors offer

horizontal and rigid floors at different heights, the constructors adopted methods of building from outside inward against these rigid surfaces. They attained that result by general arrangements and by procedures belonging to the details of construction. For example, they gave the walls projectings beyond each other inside, as we have just stated, and they built these walls of great stones externally and of low courses or rubble inside.

Note 1.p.223. See Arch. civ. et dom. of Aymar Verdier & Cattois.

Note 2.p.223. See Monog. d'abbayes. Lib. S. Genevieve.

Assume the section of a wall A B lestined to support floors (126), the external surface of this wall will be composed of high courses of stone not extended through, and each story b being separated by a stone band will be recessed an inch or so behind the next beneath. On the contrary the internal surface will be built of lower stories and will have a projection beyond that below. Thus this wall will have a tendency to incline from the exterior inward, 1, because its axis B falls at B′ inside the lower axis A; 2, because the external surface will be less compressed than the internal one. Then this wall so built will exert against the ends of the beams C a pressure, the more powerful the higher these floors are elevated above the ground. Thus it will be superfluous to tie the walls together, which far from tending to separate, on the contrary w will tend to incline toward the centre of the building.

It is evident from this example, that although the civil construction of the middle ages has its own character, distinct from religious construction, still the architects in both seek to replace inert masses by acting forces. In civil structures, the floors are regarded as struts set between the walls that tend to approach each other. Thus these floors are stiffened by the pressure of the walls, and the entirety of the building offers great stability because of these pressure against the struts.

The constructors of the middle ages made proof of great independence in the vaults belonging to civil edifices, the tunnel vault, the Roman cross vault, the Gothic cross vault with round or segmental arches, the vaults composed of spaced arches supporting ceilings or little vaults, all is good to them, according to the occasion and need. When in religious architec-

architecture they no longer used but a single kind of vault, i.e., during the 13 th and 14 th centuries, and still had the good sense not to apply this system in civil structures, whatever advantages it offered. Frequently very wide buildings required th erection of one or two rows of piers in the interior to support the floors of the upper stories, as we have s seen above; then the ground story was generally vaulted; but since these superposed posts, stayed only by the floors, were not stable, men improved this in a way at least by placing t them on the lower piers supporting the vaults, and fearing to crush the imposts of those vaults, made them independent of the piers.

Thus for example (127); let a pier A of the ground story be intended to support the vaults, on this pier were placed two or three courses B corbellet out on the four sides, thus was obtained the bearing c. At the augles were placed the imposts D on the diagonals of the square, to receive the voussoirs E of the diagonal arches of the vault; at the centre the pier G rose freely to receive the upper floors, and then the fillings H of the vaults were closed with rubble. The imposts of these vaults and its fillings received no load, and the mass forming the haunches only abutted the piers. Fearing the effects of the thrusts in the ground story on the walls, that w were not always furnished with buttresses, the constructors frequently established very strong corbels along these walls, to diminish the effect of thrusts as much as possible, and to transfer their resultant to the solid wall or even to the internal surface of these walls. On these corbels they could then permit themselves to place segmental arches, so as to occupy less height. Renouncing cross vaults or pointed vaults on the great arches perpendicular to the walls (128), they built the vertical spandrils B up to the level of the extrados of the crowns of these arches A, then they turned on these spandrels tunnel vaults C also segmental. By this means they came to vault large areas without occupying much height and without dropping the springings of the arches low enough to obstruct passage. By multiplying and bringing these arches closer together they could replace the small vaults C by slabs forming a ceiling, set on stone beams (if these materials sufficed), as shown by Fig. 129. These beams were furnished with rebates,

so as to present their upper surfaces at the level of the slabs, as indicated by the dotted line E F. These methods of building were retained very late without sensible modifications, for we still see structures of the 15 th century that reproduce these severe, grand and simple arrangements. The most beautiful examples that we know of these civil structures in which the corbellings play a very important part is the castle of Hoch-Königsburg near Schlettstadt.[1] One could take the principal halls of this castle for constructions of the 13 th century, while they were built only in the 15 th century. But Alsace has retained, especially in civil architecture, the old traditions of the good Gothic epoch. The principal structure of the castle of Hoch-Königsburg built against the rock, (130) is composed only of internal buttresses with a very thin external wall on the side of the court. It contains four stories; the ground story, that served for kitchens, is covered by segmental vaults resting on very flat arches of rubble, turned from one pier to another. The second story is covered by great platbands relieved by powerful corbels; between the platbands the parallellograms remaining are arched with rubble. The third story is covered by a wooden floor, whose main beams rest on corbels engaged in the piers. The fourth story is covered by a round tunnel vault resting on platbands, and wide corbellings arranged like those of the second story. That upper vault bears a platform or terrace covered by slabs. The perspective section (Fig. 130) gives the whole of this singular structure. It must be stated that the material of the province lends itself to this boldness (.ed sandstone); one could not with our limestones od the basins of the Seine, Oise and Aisne, allow the use of lintels of such small depth and great span.[1] But in civil and military architecture, more than in religious architecture, the nature of the materials had a very marked influence in the use of the means of construction; this example is a proof of it. The longitudinal platbands between the buttresses and the transverse ones from one buttress to another are cut with joints. If we make a longitudinal section of this building, each bay gives us Fig. 131.[2] One can form an idea of the magisterial grandeur of these buildings, if he has not seen them. Here nothing is granted to luxury; this is pure construction, and the architecture has no f

form other than that produced by the judicious use of the materials; the principal points of support of the lintels are a alone of cut stone; the rest of the structure is of rubble plastered. We confess that this mode of understanding civil construction has a special attraction for us. It must be stated that the castle of Hoch-Königsburg is built on the top of a h high mountain, eight months of the year in the midst of snow and fogs, and that in such a location it would have been ridiculous to seek architectural forms, that would have been appreciated only by eagles and vultures; that the savage appearance of these structures is in perfect harmony with the rugged location.

Note 1.p.233. See general plan of this castle in Art. Chateau, Figs. 30, 31; hall M.

Note 1.p.236. In the 15 th century an accident compelled t the owners of the castle of Hoch-Königsburg to turn arches u under the floor of the second story.

Note 2.p.236. M. Boeswillwald, who drew the castle of Hock-Königsburg with the greatest care, was very willing to place his drawings at our disposal.

In regard to this, we allow ourselves a remark not without importance. We believe we are the first to appreciate what is termed picturesque, because the 17 th century, men no longer find beauty except in parks planted in the French manner, in aligned and symmetrical buildings, in terraces covered by stone and cascades lined with lead. Without denying the value of this nature arranged by art, still we must recognize, that nature left to itself is more varied, freer, grander and also more really beautiful. A nobleman of the court of Louis XIV or of Louis XV much preferred the parks of Versailles or of Sceaux to the wild appearance of the gorges of the Alps or Pyrenees, duke S. Simon, who had no employment at court, loved better to live in a narrow and dark apartment at Versailles, than to live in his charming residence of La Ferte. Now on the contrary our lords of the middle ages were sensitive to those natural beauties, and they loved them because they lived in their midst. Without speaking of the very vivid appreciation of nature found in the numerous romances of the middle ages, we see that the castles, manors, and the abbeys are all located so as to cause their inhabitants to enjoy the out-

outlook on their surroundings harmonizes with their locations; wild and grand in abrupt places, elegant and refined at the f foot of smiling slopes, on the banks of tranquil rivers, in the midst of verdant plains. In habitations the views of the most picturesque points are always arranged with art and so as to present unexpected and varied views. When one studies the civil structures of the middle ages, it is then necessary to have regard to the place, the nature of the climate, the site, for all that exerts an influence on the constructor. A building that would be properly arranged and built on a plain, in the country with mild and tranquil appearance, would be ri- ridiculous at the top of a savage rock surrounded by precipices. Another by its severe and even brutal character, seems to belong to the desolate soil on which it rises, but would seem deformed and rude when surrounded by meadows and orchards. Those barbarous men, to say the most, were then sensitive to natural beauties, and their habitations reflected these d different kinds of beauty, so to speak, placed on harmony with them. We that are civilized, and who claim to have invented the picturesque, erect elegant pavilions on some wild site, that seems destined to support a fortress, and we build ourselves massive structures on the bank of a brook running through the meadows. That makes us believe that these barbarians of the middle ages loved and understood nature, without making a noise about it, and that we who boast of that on every occasion in prose and verse, we regard it with a distracted eye, without allowing ourselves to be penetrated by its beauties. The centuries are like individuals, they always desire one to believe them endowed with qualities that they lack, and care little for those that they possess. Everyone fought for religion in the 16 th century, and nine tenths of the combatants, on one side as on the other, did not even believe in God. Men prided themselves on chivalry and fine manners in the 17 th c century, and already at that epoch minds turned very strongly toward positive ideas and the satisfaction of material needs. In the 18 th century men spoke only of virtue, nature and mild philosophy, when virtue was scarcely in fashion, when nature was seen through the glass windows of the study, and that in fact of mild philosophy, only was practised what was based on the assured well-being of one's self and friends.

Let us return to our buildings. The system of construction by corbelling being strongly in fashion from the 12 th century in civil buildings; indeed it is iconomical and presents numerous resources, either for separating floors, to avoid great thickness of walls and considerable foundations, to receive carpentry, bear projections, to obtain larger areas in the upper stories of buildings than in the ground story, to provide lobbies, stairs communicating from one story to another, and offer shelter, etc. This was also an application of this principle of the architects of the middle ages, consisting in employing active instead of passive forces: for a corbelling is an overhang that requires a counterweight to retain the function that one claims to give it. Corbellings have the advantage in producing thrusts, always difficult to maintain in composite structures, like every habitation, the walls of small thickness intersecting each other irregularly, according to the purposes of the rooms. They take less height than arches, or their thrust may be neutralized by setting the imposts outside the surfaces of the walls, which is easy to prove.

Let A B (132) be the opening of a hall whose floor will be separated by arches, as shown by Figs. 128, 129; A C, B D is the thickness of the walls; C E the height between the floors. If we turn the arches G F penetrating into the walls, even admitting that we shall have a heavy load at K, there will be reason to believe that such a great thrust will be exerted from G to H, that the wall will bend to the outside, for the r resistance of friction of the bed G H will not be sufficient to prevent sliding; if there is no slipping, the length G H is not such that the joint could not open outside and crush i inside as shown at I, the effect that will cause the bending of the wall, and consequently the fall of the arches. But if we have a strongly projecting impost L and two corbelled courses M N, assuming a reasonable load K′, we can resist slipping by a bed L O much longer and with greater friction; the curve of pressure exerted by the arch penetrating the bed L O at P will find there a component, that will be combined in a line P R, more or less inclined inversely as the greater or lesser weight of the upper load K′. If this load be very great, the point R or resultant of the thrusts may be vertical and fall within the internal surface of the wall or nearly so; that is

all that one can ask. The constructor takes care in this case to place at least one course having its its internal vertical surface in the vertical through the intersection of the arch with the corbelled impost, for he thus increases the resistance of the thrust by the friction of the two beds of the stone, while if he places only a single corbelled course under the impost, as we have sketched at S, he will have for opposing the thrust only the resistance of the bed T V, and the b bending of the wall may be produced at Y as it was produced at H'. When constructors for any reason could not give to their corbelling the height of three or four courses, then they obtained very resistant stones, and (133) they set these to project as indicated in section A, so that the curve of pressures of the arch falls at B inside the inner surface of the wall; then the stone A tends to tip, and they relieved it by a small projection C; its tipping movement describes a part of a circle with centre D. To resist this movement of tipping, there is the load E with the filling F in masonry. Not being able to tip, the corbelling A no longer tends except to slide from B to G. Now it is necessary to make the friction sufficiently strong on the bed D G by means of the vertical load E to prevent this slipping. Corbellings then possess two properties; the shortening of spans by means of overhangs held by l loads on their tails, and the action of resistance to oblique thrusts by increasing the surfaces in friction.

Thus one recognizes that in all cases the constructors of the middle ages employed active resistances, i.e., the system of equilibrium instead of the principal of passeve resistance of Roman construction. Besides, as always these constructors pushed the consequences of an accepted principle to its last limits; they did not seem to know those impossibilities that our modern art opposes in the form of an academic veto to bold experiments. Construction for them is not that science which consists in saying; "Here are the rules and examples, follow them, but do not go beyond them." On the contrary, science for them said; "Here are the general principles, they are broad and indicate only the means. In application extend them as m much ar the materials and your experience permits you; we only ask you to remain faithful to these general principles; besides all is possible to him that knows how to apply them."

Is that a stationary and hieratic art, foreign to the modern spirit, as some claimed so long to make us believe? Is it merely to retrograde to study it, to become permeated by it? i Is it the fault of that art if many only interpret it by its external appearance, compromising its development by unskilful imitations? Shall we attribute to antiquity the bad copies of its arts? Then why do we refer to the arts of the middle ages in France the false applications that one can make of t them, whether in Italy before the Renaissance or among us in our time? From the moment when it was admitted that there was no architecture except in Italy, that architects have been l like sheep following each other, to study art in that country, academic instruction has only wished to see the middle ages there. Now the edifices of the middle ages in Italy are structures of moderate extent, from the point of view of construction. Nearly always they are only constructions derived from Roman antiquity, clothed in a very bad exterior borrowed from the arts of the North or the East. Certainly it is not that which one should go to study beyond the mountains. As for construction, one finds neither fixed principles nor sequence, but a disorderly mass of confused traditions, of influences o opposing each other, a barbaric love of luxury beside evindent lack of power.[1] For example, what are the basilicas of Rome, mostly rebuilt in the 13 th century, if compared with the edifices erected among us at that epoch? Bad brick walls, badly joined to shafts and capitals torn from antique monuments. In these barbarous structures, where are art and study? If we c consider them with respect and curiosity, is this not because they present to us the spoils of magnificent edifices? If we marvel before rich jewels pillaged in a palace, does the pillage arouse our admiration? Let us then be sincere, and put th things in their true places. If the Romans of the middle ages found a soil covered by antique ruins, if still in the 13 th century the baths of Antonine caracalla were standing and about intact, as well as the Coliseum, Palatine and so many other edifices, do we go to admire the works of men more barbarous than the Vandalsand Huns, who coldly destroyed those monuments to erect bad structures, in which even these ruins are unskilfully employed, rudely placed in the work; we see appear there only the variety of a weak people; intelligence, ideas

and finally art are entirely wanting. What a different sight among us! Then the lay architects in France carried on their labors persistently, without thinking of their personal glory, they only sought to develop the principles tha they knew how to discover; they believed the future to be before them, and this was not an illusion, for they first commenced in the modern era the great struggle of intellectual men against brute matter. The constructors of antiquity are the allies and frequently the slaves of the materials and they submit to their laws; the lay constructors of the middle ages declare themselves its antagonists, they claim that the mind must be right, that it must subjugate the latter, and that this will obey. Is it well for us, who pierce mountains to travel with more ease and more rapidly, who no longer take account of distances and defy natural phenomena, to scorn those, who by their investigating and subtle minds, their disinterested faith in principles based on reason and calculation (certainly disinterested, for scarcely any have left us their names), preceded us by several centuries, and only were wrong in appearing too soon, being too modest, and of having believed that they would be understood. It is said that history is just; that is to be desired; but its justice sometimes delays a long time. We grant that from the 12 th to the 15 th centuries, political society was disordered, the clergy were ururping, the feudal lords were tyrants, the kings were ambitious, sometimes supple and sometimes perfidious; Jews were usurers, and the peasants were miserable brutes, that this society was influenced by ridiculous superstitions, and cared little for morality; but we see in this chaos appear without noise a class of men neither religious, nobles nor peasants, possessing the most abstract art, that leading itself to calculations and l logical developments; of the art to which everyone must resort, for it is necessary to lodge, guard and defend one's self, to build temples, houses and fortresses. We see that class at attract around itself all the artisans, and subject them to its discipline. In less than a half century, this assciation of tireless workers has discovered principles entirely new, and that can be infinitely extended; it has introduced into all the arts analysis, reasoning and research, instead of routine and decrepit traditions; it founds schools; it marches

on without stopping for a day, isolated but orderly, tenacious and subtle in the midst of anarchy and of general indecision. It ascends the first steps of modern industry, of which we are justly proud, and because this association passes its time in work instead of writing memoirs in its praise; because its members, more careful to make their principles triumph, than to obtain personal glory, inscribe their names on some stones; that by force of research they attain even to the abuse of those principles; because that finally thi association is concealed under the three last centuries, whose vanity at least equals their splendor, should we be ungrateful enough today not to recognize what we owe it, foolish enough not to profit by its labors? Why is that ingratitude and folly? Because some idle minds have made their decision, and pretend to preserve the principles of a dead art, which they avoid putting into practice, and that they do not even state clearly? Who are the retrograde minds? Are they those that condemn us to reproduce forever the incomplete or badly understood attamots made by the three last centuries to revive the architecture of the Romans, or those who seek to place in honor the resources of an art both reasoned and bold, lending itself to all the combinations and all the developments required by the varying needs of modern civiliaation? The scales of the history of the arts would be just if held by an impartial hand, if one did not always lay on its scales names instead of facts, individuals in place of monuments. What have we indeed to o oppose to names like those of Dioti Salvi, Arnolfo di Lapo, B Brunelleschi, Michelozzo, Balthazar Peruzzi, Bramante, San M Micheli, Sansovino, Pirro Ligorio, Vignola, Ammanati, Palladio, Serlio, Jean Bullant, Pierre Lescot, Philibert Delorme, Du Cerceau, etc.? Two or thre scarcely known names. But if our French monuments of the middle ages could speak; if they could give us the modest names of their authors, if above all before the works of men just cited, they could show us all t the mysteries of their construction, certainly then history uould render justice to them, and we should cease to be the dupes, to our injury, of a mystification lasting for more than three centuries.

Note p.241. A single example to prove that we do not exaggerate. We have seen in this Article the series of persistent ef-

efforts the constructors of the North have succeeded in making themselves masters of the thrust of vaults, and in what conditions they wished to ensure stability of these vaults. Now in Italy the spreading of the arches of monuments vaulted in the middle ages and even the Renaissance is opposed by means of i iron bars placed at their imposts and remaining visible. On this account, they could well omit flying buttresses and the entire equipment of buttresses and combinations for equilibrium. Men take good care not to reproduce those iron bars in the drawings given to us, or to speak of them in works on the matter. But in truth is that a means of construction? Is it not rather a confession of weakness?

Western Europe can justly glory in having aroused the great intellectual movement of the Renaissance, and we are not of those that regret this return to the arts and knowledge of p pagan antiquity. Our century comes after that of Montesquieu and of Voltaire; we do not disown those great minds, we profit by their clarity, their love of truth, reason and justice; t they opened the way to cirticism, and extended the domain of intelligence. But what do they teach us? Would it be by chance to compel us to reproduce forever their ideas, to conform ourselves to their personal tastes without examination, to p partake their errors and their prejudices, for they are no more exempt from these than others? That would be to understand them badly. What do they say to us on each page? "Instruct y yourselves, do not stop; leave aside opinions already formed, these are almost always prejudices; the mind was given to man to examine, compare, collect, and chuuse, but not to conclude, for the conclusion is the end, and very foolish is he that p pretends to say; I have closed the human book!" Is it then a the especial taste of some philosopher that must be taken as a model, or his mode of reasoning, his method? Voltaire did not love Gothic, because Gothic belonged to the middle ages, whose last prop he undermined, that proves only that he knew nothing of that art, and that he obeyed a prejudice; it was a misfortune for him, not a rule of conduct for artists. Let us endeavor to reason like him, let us bring to the study of our art his spirit of analysis and of criticism, his good se sense, his ardent passion for what he believed just, if we can, and we shall come to find that the architecture of the

middle ages is based on novel and fruitful principles, different from those of the Romans! that these principles can be m more useful today that are Roman traditions. The rare minds that have acquired in their time a great influence are like those torches, that light only the space where they are placed, they can make clearly appreciated only what surrounds them. Does that mean that there are in the world only the objects on which they cast their light? Place them elsewhere and they will cast the same light on other objects. But we are so made in France; we regard lighted objects without caring for the torch, without ever transferring it elsewhere to aid us by its light in order to examine everything. We prefer to adhere to judgments pronounced by the minds of the elect, rather than to use their mode of examining the facts, to judge for ourselves. That is in truth more consistent. We admire t their boldness, the extent of their views, but we do not dare to be bold like them, to seek to see farther than they, or to see anything that they neither desired not could see.

But we are very far from our masters of the middle ages. Let us return to them, the more that they scarcely mistrusted probably, that it would be necessary some day to spoil so much o paper in their own country in an attempt to make their efforts and progress appreciated. In advance of their age by the extent of their knowledge and even more by their independence as artists; scorned by more enlightened centuries, that would n not take the trouble to understand them, in truth their destiny is sad. Will the day of justice never come for them?

The needs of civil construction are much more varied than those of relegious construction; hence civel architecture furnished to the architects of the middle ages opportunity to exhibit the numerous resources, that they could find in the principles to which they were subject. It is necessary to properly define these principles, for they have a great importance. The architecture of the Renaissance (not that of the Geeeks, be it fully understood),[1] is a construction covered by a decoration, that thus becomes in fact the visible architecture. If one restores a Roman monument, two operations are necessary; the first consists in taking into account the means employed to erect the carcase, the structure or actual edifice; the s second is to know how this structure has arsumed a form more

or less beautiful, or more or less well adapted to this body. We have taken into account this method elsewhere.[2] This system has is advantages, but it is often merely a skilful lie. One can study Roman construction indefendently of Roman architecture, and this prowes that the artists of the Romans studied the external form without considering the body that it covered. Architecture and construction of the middle ages cannot be separated, for that architecture is nothing but the form determined by the construction itself. There is not one member of Gothic architecture, however small, at the epoch when it passed into the hands of laymen, which is not imposed by a necessity of construction, and if Gothic construction is very varied, this is because the needs to which it must submit are numerous and varied themselves. We do not hope to bring under the eyes of our readers all the applications of the system of civil construction among the peoples of the middle ages; we can no more that claim to trace in main lines the principal ways pursued by that system; for one of the most striking characters of the art as well as of the manners of the middle ages is to be individual. If one wishes to generalize, he falls into the strangest errors, in the sense that the exceptions exceed the rule; if he desires to take account of some of these exceptions, he knows not what to choose, and he restricts the study. We believe that he can emphasize the principles, which are simple and rigorous, and seek among the applications, those best aud most clearly expressing these principles.

Note 1.p.245. For architects who have studied somewhat the arts of antiquity, the difference between the architectures of the Greeks and of the Romans is perfectly distinct; those two arts follow opposite paths, as we have stated many times; but for the ordinary people this is not the case, as they confound those two arts, as if one were not derived from the other. How many times has it not been said or written, for example, that the portal of S. Gervais at Paris is the portal in Greek architecture? It is scarcely more Greek than Roman. Yet on such blind judgments has the criticism of architecture been based among us for a long time, and that because we architects, perhaps by indifference, we are the only ones in France that do not write on our art.

Note 2.p.245. See our Entretiens sur l'architecture.

The several examples that we have given illustrate, we hope, the consequences of the principle adopted by the lay architects in the construction of the middle ages; appearance of the means employed in the construction of edifices, and an appearance really producing the architecture, i.e., the visible form; solutions of the given problems by the natural laws of statics, of equilibrium of forles, and by the use of materials in accordance with their properties, acceptance of all programmes, however varied, and subjecting the construction to these programmes because of the architecture itself, since this architecture is only the frankly accepted appearance of that c construction. With these settled principles, with some examples selected amoung the applications of these principles, there is no architect that could not construct like the masters of the middle ages, proceed like them and vary the forms according to the novel needs, that perpetually arise in the midst of society like ours, since each new need must incite a new application of the principle. If we are accused of desiring to cause our art to retrograde, it is well at least that you should know how we intend to bring it back; the conclusion of all that we have said being:- "Be true." If truth be a sign o of barbarism or ignorance, we should be happy to be relegated among the barbarous and ignorant, and proud of having led some of our colleagues with us.

Corbellings play an important part in civil structures, for which we have given the reason above: it remains to pursue a the varied applications of that method. There exist in the p part of Champagne adjoining Burgundy, and vice versa, houses otherwise very simple, built during the 13 th and 14 th centuries, that have a gable on the street, and consist externally of a sort of porch with balcony above, sheltered by a very projecting roof. The entire system only consists of corbellings skilfully combined. Thus (134) the eave walls support a first corbelling at right angles, designed to support a beam receiving the ends of the joists of the floor of the second story also resting on the rear wall. This beam is surmounted by a railing. A second corbel A gives the eave walls a projection that protects the balcony and receives a gable truss arranged to support the floor of the attic, and to permit taking prov-

provisions into that attic. The wall thus set back vertically over the wall of the ground story is only a wooden partition. Note that the second corbel - (134 bis) leaves above its last course H a portion of the vertical wall H I, so as to load t the tails of the corbel stones by a mass of masonry. Behind i is the half timber wall G, which encloses the second story. To avoid all chance of the overturning of the corbelled mass, the double plates N that carry the roof and crown the entire lengths of the eave walls, have at their ends strong keys O, that maintain the heads of the corbels. That very simple arrangement is found in many peasants' houses.(Art. Maison).

But let us see how in the richer buildings, more complicated and more important, the constructors came to use the corbellings with skill, submitting to the arrangements required by a particular need. It concerned the opening of a doorway in the reentrant angle formed by two buildings intersecting at a right angle, a very convenient arrangement also, and that was often demanded by the occupants of a manor or of a house; to allow the doorway to give entrance to the halls of the ground floor at right and left, and then in the second story; to suppress that cut-off angle in which the door was opened, to recover the right angle formed by the intersection of the two walls, that at least one of the two extends in a dividing wall, and to then establish above that doorway and in the reentrant angle a service stairs communicating from the second to the upper stories. By means of ironwork covered with plaster, one can easily satisfy the programme today. But if it is necessary to not lie in the construction, the matter becomes less easy. Then let (135) be the plan of the ground story of that construction and plan B be that of the second story. One sees at C the door opened in the cut-off angle: at D are the internal piers' at E is the horizontal projection of the enternal corbel supporting the reentrant angle, and at F is the horizontal projection of the corbels supporting th projecting angle; G G are arches abutting the rentrant angle and supporting the division walls of the second story. We presnt (136) the external view of the doorway with the corbels, that serve as a hood a and bear the projecting angle of the service stairs traced on the plan P of the second story. Even if necessary, these corbels can mask a machicolation destined to defend the doorway.

Fig. 137 gives the internal view of the porch with corbels s supporting the reentrant angle; at G are the two arches abutting these corbels and supporting the upper division walls. The newel of the stairs rises over the middle of the cut-off corner, and the internal and external corbels are maintained in equilibrium by the opposed weights of the two projecting angles of the enclosure of that stairs. Men have since desired to obtain similar results by means of trumpets; but these trumpets load the lower masonry much more than the system of c corbels, require more and larger materials, stonecutting difficult to draw and still more to execute. That is therefore not an advance, unless one regards as an advance the pleasure given to a stonecutter to show his knowledge at the expense of the purse of whoever builds.

If during the 14 th and 15 th centuries, relegious structures modified but little the methods applied to the art of building by the architects of the 13 th century, it is not the same in civil structures. These assume a franker charm; the procedures employed are more extended and the methods more v varied; the architects make proof of that independence lacking to them in religious monuments. Already indeed life withdrew from religious architecture and carried all its energy into civil structures. Under the reigns of Charles V and of Charles VI, the development of architecture applied to public edifices, to castles and houses, is very rapid. No difficulty arrested the constructor, and by extending the principles adopted by his predecessors, he came to execute the boldest structures, and best understood from the double point of view of stability and of art. At that epoch some lords knew how to give an unusual impulse to constructions, then loved them, as it is necessary to love them, leaving to the artist entire liberty in the means of execution and the character appropriate to each building.[1] The dukes of Burgundy and Louis of Orleans, brother of Charles VI, caused to be erected residences, half fortresses and half pleasure palaces, that indicate in the artists to whom were entrusted these works, an experience and rare k knowledge, at the same time as a perfect taste; in the lords that ordered these works, a wise and well understood liberality, which since then is scarcely a quality peculiar to personages wealthy and powerful enough to undertake great struct-

structures. If Louis of Orleans was a great spender of public funds, if he abused the state of lunacy into which his brother the king had fallen, it must be recognized, that as a great lord with immense wealth, he built like a man of taste. He almost entirely rebuilt the castle of Coucy, erected the residences of Pierrefonds, of Ferte-Milan, and enlarged those of Crepy and of Bethisy. All these structures undertaken under the orders of that prince were of a rare execution and beauty. One finds there what it is so difficult to combined in the s same edifice, perfect stability, strength with elegance, and that richness and good good quality, that leaves nothing to c caprices. From this point of view the buildings of Coucy erected about 1400 have all the serious dignity of Roman structures, all the grace of the most delicate conceptions of the R Renaissance. Leaving aside the style of that epoch, one is o obliged to recognize in the architects of that time a very m marked superiority over those of the 16 th century as constructors, their conceptions are broader, and their means of execution are more secure and wiser. They know better how to subordinate the details to the whole and built more solidly. The great hall of the castle of Coucy, called hall of the knights, was a perfect work (Art. Salle); We shall show here only certain parts of it pertaining more particularly to the object of this Article. That hall rose in the second story over the ground story, whose vaults rested on a row of columns and on lateral walls. It was not less than 52.5 ft. wide with a length of 196.9 ft.; i.e., it could easily contain 2000 persons. At one side it received light from the country through the t thick curtains of the castle; on the other from the internal court. (Art. Chateau, Figs. 16, 17). Two enormous fireplaces warmed it, and the lateral openings were six in number, three on the outside and three on the court, without counting an i immense window opened at the South beneath the wooden vault. The side openings were surmounted by dormers intersecting the roof. Here (138) is the section of that hall taken through o one of the side windows with the dormer opened above it, and (139) is the perspective view of the interior of that window, that has a jamb not less than 13.1 ft. wide. The platband covering it is cut in 10 voussoirs, set with great care, which are held by the curtains not less than 13.1 ft. thick, and are

maintained horizontally without the aid of any ironwork. In the perspective view, we have assumed the roof removed at A, so as to show the construction of the dormer from the interior. These dormers (see the section) open on the broad external covered way with battlements, so that at need the men posted on this defensive gallery could speak to persons placed in the hall. The defenders were covered by a little roof placed on the battlements and on isolated piers -. Daylight entered without obstruction into the hall by the dormers, and this construction is on such a great scale, that from the hall at B one could not see the top of the roof of the defensive gallery, as shown by the dotted line B C.[1] No trace now remains of the carpentry, and today one finds in place of that beautiful construction only the windows of the lower part of the dormers; which further suffices to give an idea of the grandeur of the arrangements adopted. In the hall of the knights (or Prussians) belonging to the same castle, we still see w the windows whose jambs are covered by arches, as indicated in Fig. 140, so as to bear a considerable weight of masonry. The imposts of the doubled discharging arch advance to the intersection of the splay with the jambs A (see plan) of the window, so as to avoid skew cutting of the voussoirs, whose intradoses are thus parallel to each other. The upper arch alone extends to the exterior and completely relieves the lintel.

Note 1.p.232. Nothing seems to us more disastrous and ridiculous than to desre, as occurs but too frequently today, to impose on architects anything but the programmes. nothing gives a more gloomy idea of the state of the arts and of those professing them, than to see the artists accept all the extravagences imposed by persons ignorant of practice, under the pretext that they pay for them. Tailors on this account have more moral worth than many architects; for a good tailor, if one orders from him a ridiculous garment, would say:- "I cannot make a garment that would disgrace my house and would make men laugh at you." This evil already dates far back, for our good Philibert Delorme wrote about 1575:- "I tell you, that for thirty years and more, I have observed in various places, that the best part of those, that have built or desired to e erect buildings, have commenced them suddenly, after having s slightly deliberated on them; which is most frequently followed

by repentance and derision, that always accompany those badly advised, so that those thinking to understand well what they would do, have desired the opposite of what they could and s should do well. And if by chance they ask from some one advice on their considerations and enterprises, this would be a master mason or carpenter, a notary, and others asserting themseelves to be very skilful, most generally scarcely having better judgment or advice, than those asking it from them. Many times I have seen great personages, who decide themselves, b because most of those about them never wish to contradict them, desiring to please them, or indeed because they do not un understand it, and reply at once; "That is well said, Monsieur; this is a beautiful invention, that is well found, and you show well that you have a very fine understanding; never will be seen such a work in the world." But the bad persons' think just the contrary, and speak it privately, perhaps otherwise. That is how some lords deceive themselves and are satisfied with their works." We could cite the entire first six chapters of the first six chapters of the treatise of Philibert Delorme; we refer our readers to it as a masterpiece of g good sense, reason, wisdom and honesty.

Note 1.p.256. Thesee great halls were usually paved with s stone slabs; these were washed daily, the gargoyles were reserved for the discharge of the water. "The blood of the victims ran from all parts and streamed through the openings made near the thresholds of the doorways." Nibelunger Lied. 35 th adventure.

But it is unnecessary to state that the constructors employed this strength of means only in very considerable buildings, that must resist less the effect of time than the complex destruction by men. It even seems that in interiors of castles, where one could not fear attack, the architects wished to distract the eyes of the enhabitants by very elegant and light constructions. It is known that Charles V caused to be made in the Louvre at Paris a stairway and galleries, that passed for masterpieces of the art of building, and that attracted the admiration of all connoisseurs until the moment when these precious structures were destroyed. Especially the stairways, which present numberless difficulties to constructors, excited the emulation of the architects of the middle ages.

There was no lord that did not desire to have a stairway more elegant and better designed than his neighbor, and indeed the little that remains to us of these indispensable accessories of the castles always indicates a certain research as well as great skill in the art of designing.(Art. Escalier).

For more modest habitations, those of the citizens of cities, their construction also became during the 14 th and 15 th centuries lighter and more labored. Then men commenced to wish to open very large windows on the public street, the more necessary as the streets were narrow, that men skiluflly combined wood with stone or brick; that they sought to gain space in interiors by diminishing the points of support,by encroaching on the public way by projections given to the upper stories; that consequently the constructors were led to return to half timber work on the facade.

We do not wish to extend beyond measure this Article, already very long, and to give here examples that find their palces in the other Articles of the Dictionary; we have only tried to show the profound differences separating civil from r religious construction in the middle ages. Our readers will indeed refer for more ample details to Arts. Boutique, Charpente, Cheneau, Egout, Escalier, Fenetre, Fontaine, Galerie, Maison, Pan-de-Bois, Plancher, Pont, Porte, etc.

CONSTRUCTIONS MILITAIRES. Military Structures.

Between the military structures of the first times of the middle ages and Roman structures, one cannot state that less perfection was employed in the use of the materials and the execution; the procedures are the same; the curtains and towers are only composed of masses of concrete faced with small rubble or a very little dressed ashlars. It seems that the N Normans first applied in the execution of military works certain improvements before unknown to them, and that mave after the 11 th century a merked superiority to those structures or over those existing on the soil of western Europe. One of the most notable improvements was the rapidity with which they b built their fortresses. Willian the Conqueror in a few years covered England and a part of Normandy with strong castles of masonry, executed with perfect solidity, since we find a great number of them standing today. It is to be believed, that the Normans settled on the western soil employed procedures

used by the Romans, i.e., levies for building their fortresses, and in a country entirely subjected, this is the most suitable means for erecting vast structures, that only require a considerable mass of materials and many men. Besides one does not find any trace of art in the primitive military structures of the Normans, all is sacrificed to the material need of defense. This sort of structures have nothing that can furnish material for analysis; they have an interest only from the point of view of defense, and in that respect their arrangement is found described in Arts. Architecture Militaire, C Chateau, Donjon, Tour.

It is scarcely before the end of the 12 th century, that we see employed procedures in construction peculiar to defensive works, forming a separate art. For massive concrete opposing an equal and continuous resistance were substituted points of support connected by discharging arches, thus forming in the curtains as in the towers points more resistant than others, endependent of each other, so as to avoid the fall of great parts of masonry, if they were undermined. Then also was attached a great importance to the sites of military works, so t that constructors chose rocky soils difficult to penetrate by mining, and that they frequently cut the rock itself to obtain indestrictible precipices, that indeed during the great sieges undertaken at that epoch, notably by Philip August, the sap and the mine were the means most commonly employed to overthrow the walls. (Art. Siege).

One of the reliefs that decorates the western facade of Notre Dame La-Grande at Poitiers, and that dates from the beginning of the 12 th century, already represents to us the walls of a city composed of discharging arches resting on slightly projecting external buttresses (141). But it is necessary not to rely too much on those representations of monuments, that are not always conformed to the reality. When discharging arches exist, they are ordinarily apparent on the interior of the walls and support the defensive gallery, and are masked by the external surface. Simple good sense indicates, that discharging arches on the exterior indicated to the assailants the points to undermine, and that the projections of the buttresses concealed the pioneers. Then one must regard this example as the reverse of the wall for the needs of sculptured ornamentation.

The intellect that we see dasplayed by French constructors about the end of the 12 th century in religious and civil edifices occurs again in the military structures; they think of replacing the passive forces of Roman construction by active forces; but in military architecture, it is not only to resist external forces and the natural laws of gravity, but to o oppose a resistance to the destructive hands of men. The logic of the artists who developed the art of architecture in the middle ages, and made it leave the arts of the Romanesque, is rigorous; we have had occasion to demonstrate this to our readers in the two first parts of this Article; it will be understood that this logical and true mind found a fine opportunity to exert itself in the construction of military edifices, where all must be sacrifeced to the needs of defense. Sap and mining practised by means of struts to which fire was set,being the principle of the most common attacks in the 12 th century, it was necessary to oppose to this principle a system capable of making useless the works of the assailants. If then we erect a tower according to the plan A, and the miners attach themselves to the two near points of the outer surface, (142), and excavate the two holes B C,placing in them little posts, when they se fire to these posts the entire portion E F of the tower will fall outward and the work will be destroyed; but if by using the same volume of materials and occupying the same area of solids, we take care to erect, instead of a solid wall, a series of niches between internal buttresses as indicated in plan G, there is an equal chance that the miner will come below a void, instead of under a solid, and then his work and burned struts will produce no results; but if he attaches himself beneath a solid, that offering greater thickness than in plan A, his work will be long and more difficult; the recesses also allow counterminius, if he works beneath those niches. Further the niches H can themselves be supported by struts inside, so as to render impossible the fall of a part of the tower, assuming that the holes of the mine are made at I and K under the piers. Thus already about the end of the 12 th century, with a volume of materials equal to or even less than that previously employed, military constructors had come to give a much stronger site to their works. Further, the constructors inserted in the thickness of the walls

large timbers held together by iron pins, to encircle their towers at different heights. The principle was excellent, b-ut the means was very bad; for these timbers were entirely d deprived of of air, rapidly heated and decayed. Later was perceived the very quick destruction of these timbers, and they were supplemented by ties composed of iron cramps fixed in t the beds of the courses.(Art. Chainage).

There is one remark that everyone can make,,and which cann-ot fail to be interesting. Mortars generally employed during the 12 th and beginning of the 13 th centuries, in churches and most religious structures, are bad, lack body, are unequ-ally mixed, even the sand often being wanting and replaced by stone dust, while mortars employed in military structures at that epoch, as well as before and after, are excellent and f frequently equal Roman mortars; it is the same with the mater-ials. Stones employed in fortification are of superior quali-ty, well chosen and quarried in large blocks; on the contrary is emphasized great negligence or bad economy in most religio-us structures. Evidently when the aly nobles caused the build-ing of fortresses, they had retained the Roman system of lev-ies of supplies that the abbots and bishops would not or could not maintain. It seems that the Norman lords were the first to reorganize the system of labor on buildings employed by the Romans,[1] and their example had been followed in all the prov-inces of the North and West. Enthusiasm produced great things, but its duration was brief. It was a feeling of reaction aga-inst barbarism, that had caused the erection of the abbey ch-urches and the vast structures surrounding them, and a desire of liberty of movement and faith, that had caused the building of the cathedrals (Art. Cathedrale); but when these moments of effervescence had passed, the abbots and bishops found only a chilled devotion; consequently negligence or deception in the execution of the works. With the lay nobles it could not be thus; they did not demand devotion from the peasants, but required from them levies regularly made under inflexible su-pervision. This method was certainly better for executing la-rge works. Hence we should not be surprised by that hatred of feudal fortresses transmitted among us from generation to gen-eration, and the affection that the people had retained for centuries for their cathedrals. At the end of the last (18 th)

century many churches were indeed destroyed, particularly monastic churches, because they belonged with feudal establishments; but cathedrals were scarcely destroyed, while all castles were devastated without exception, and many had even been ruined under Louis XIII and Louis XIV. For us constructors, w who have only to state facts here, that everyone can deduce the consequences according to his way of seeing things, we a are obliged to recognize that from the point of view of labor and material, one finds in the fortresses of the middle ages an uniformity and certainty of execution, a regular procedure and an attention, that is lacking in many of our religious e edifices.

Note 1. p.261. In Normandy there existed during the middle ages a class of peasants placed under the general name of tenants (borders). The tenants were subject to the hardest labors, and among others to labor on buildings, such as transportation of materials, earthwork, etc.; in brief, they helped the masons. (See Etud. sur la cond. de la classe agric. en N Normandie au moy. age, by Leop. Delisle. 1851. p. 15, 20,78,83, and notes on p. 708).

In the construction of churches one notes interruptions, experiments, frequent modifications of the original projects; w which are explained by lack of money, more or less lively zeal of the bishops, chapters and abbots, the new ideas that arose in the minds of those that ordered and paid for the work. All that is benewolently placed to the acount of the ignorance of the masters of works, and the weakness of their modes of execution.[1] But when a powerful lord desired to have a fortress erected, he was not reduced to solicit gifts from his va vassals, to warm the zeal of the lukewarm, and to trust to t time and his successors an complete what he undertook. He desired his castle during his life, and it was a pressing and immediate necessity. Nothing troubled Richard Lionheart when he desired to erect a fortress at Andelys, a castle Gaillard, neither usurpations, sacrifices, violence nor money; he commenced the erection of the place in spite of the archbishop of Rouen, although the city of Andelys belonged to the latter. Normandy was placed under an interdict at the instigation of the king of France. The matter was carried to the feet of the Pope, who concluded an indemnity in favor of the prelate and

raised the interdict. But during these protests, threats and discussions, Richard lost not a day; he was there supervising and hastening the workmen; his fortress arose and was well built within one year, the mountain and ditches cut, the place in a complete state of defense, and one of the strongest in the North of France. When Enguerrand III caused the erection of the castle of Coucy, this was in the foresight of an approaching and terrible struggle with his sovereign. A month of delay might have stranded his ambitious projects, so one can still see today that the enormous works executed under his supervision were carried on with surprising rapidity, one that allowed no negligence. From base to summit, these are the same materials and the same mortar, and even better, the same marks of workmen; we have counted more than a hundred of these on the surfaces still visible. Now each workman's mark belonged to one stonecutter, as still today in Burgundy, Auvergne, Lyonnais, etc.[1] A hundred stonecutters in our days give the following proportions of the other kinds of workmen, assuming a structure similar to that of Enguerrand III.

Stonecutters.	100.
Draftsmen, detailers, foremen and transportation.	20.
Movers, hoisters and setters.	100.
Diggers, laborers, tanners.	200.
Masons and helpers.	200.
Quarrymen and limeburners.	100.
Haulers of sand.	25.
Wagoners and helpers.	50
Total,	795

Or in round numbers, 800 men.

Note 1.p.262. For example, men do not fail to state that two centuries were spent in building such a cathedral, without thinking that in these two hundred years, work proceeded only during ten or twenty years.

Note 1.p.263. The marks cut on the visible surface by the stonecutters were made to permit the foreman of the yard to verify the work of each man; these marks prove that the work was paid for by the piece, the task and not be the day (Art. Corporation), further they give the number of workmen employed, since each had his own mark.

Eight hundred workmen occupied with the masonry alone assu-

assumes a nearly equal number of carpenters, smiths, plumbers, roofers, pavers, joiners and painters (for all the interiors of the castle of Coucy were painted on fresh plastering). One may then admit that at least 1600 workers labored on the construction of that fortress. And if we examine the construction of the edifice; the uniformity of the cutting and setting, the perfect unity of the conception in its entirety and details, uniformity of the mouldings, indicate a rapidity of execution, that rivals what we see done in our days. Such activity ended in results as perfect in regard to execution, that are only exceptionally found in religious structurer, as for example on the facade or Notre Dame of Paris, in the substructures of the cathedral of Rheims, and in the nave of the cathedral of Amiens. But these are special cases, while in the f fortresses of the middle ages from the 12 th to the 15 th centuries, one always finds traces of that haste at the same time as excellent execution, well conceived plans and studied details, no experiments nor indecision.

For example, let us take one of the angle towers of the castle of Coucy, that each have 49.2 ft. diameter outside, not including the lower slopes. Each of these towers contains five stories and the story of the roof. The lower story, whose floor is a little above the external ground, has a segmental domical vault between the walls,with a thickness of about 11.5 ft. plus the bottom slope. Above that story, which is o only a cellar intended for provisions, rises a story with cross vault with six sides internally. The other stories are covered by floors. Here (143) are the superposed plans of the stories above the cellar. The piers of the hexagon are set alternately, solids above voids, so that in perspective section we see the piers rise above the crowns of the pointed arches forming niches between the piers, as indicated in Fig. 144. This construction avoids the separation, that might be produced and is ordinarily produced in a cylinder containing niches ope ed over each other; it also permits opening slots alternately covering all points of the horizon. We assume as destroyed the vault of the lower story over the cellar in order to allow the entirety of the construction to be seen. One can d descend into that cellar only by the opening pierced at the crown of the vault. It is understood now such a structure, r

resting on a solid mass and on a lower story whose cylindrical walls are very **thick** and are reinforced by an external slope, strengthened in each story by means of alternating piers, must defy all efforts of undermining; for to overthrow a tower built thus, it would have been necessary to undermine half its diameter, which was not easy to execute at the top of a precepice, ind in presence of a garrison possessing subterranean exits to the exterior.

Let us now examine the construction of the keep of Coucy, built by Enguerrand III about 1225. This is a cylinder more than 98.4 ft. diameter outside with a height of 196.9 ft. It contains three vaulted stories of 42.7 ft. height each and a platform with battlements. The floor of the ground story is 16.4 ft. above the bottom of the ditch. and from this internal floor to the pavement of the ditch, the cylinder has a conical batter. The masonry is solid for the height of the two lower stories and is 18.0 ft. thick, and is further strengthened by internal piers forming 12 buttresses supporting the springings of the valuts. (Art. Donjon).

Fig. 145 gives the section of that enormous tower. The lower niches are shored at mid-height by arches A forming recesses made above the floor, suitable for classifying arms and machines. In the second story the niches between the buttresses rise to the vault, and their arches are its side arches. In the third story the construction could be lighter; so the cylinder recedes in the interior to form a raised gallery B allowing a very great number of persons to assemble in the upper hall. But it is necessary to explain the remarkable consrsction of that gallery. In plan one fourth of this story of the keep is presented by Fig. 146. On the twelve piers A B rest the transverse arches of the crown C taking the palces of side arches for the great central vault D. Those piers A B have their side surfaces parallel. From points b are turned other transverse arches G parallel to the arches C, but more open, and whose imposts penetrate the skew surfaces of the piers. On the transverse arches C and G are turned pointed tunnel vaults E F. Other tunnel vaults I K parallel to the sides L of the polygon with 24 sides rest on the piers e, on the faces M' on the corbelled projections O. The perspective section seen from the point P is given by Fig. 146 bis, which

explains the intersections of the arches and tunnel vaults w with these skew vertical surfaces.

The plan Fig. 146 and the prespective section Fig. 156 bis show clearly enough that at the beginning of the 13 th century the architects were familiar with the most complex combinations of vaults, and that they knew how to vary the arrangements according to the needs. These are no longer religious c constructions. These buttresses that project to powerfully strengthen the external cylinder and abut it by means of the tunnel vaults I K of the plan 146, indicate a very wise observation of the effects, that might be produced in such structures; and indeed although the engineer Metezau loaded a mine chamber at the centre of the keep and blew it up, he only succeeded in blowing the vaults into the air and cracking the t tower at three points in its diameter without overthrowing it. The enormous cylinder produced the effect of a tube charged with powder and throwing out the vaults like shrapnel. This upper gallery supported a broad defensive gallery D (Fig. 145) open to the sky, and the central vault was covered with lead.

At F (same Fig.) are wooden ties 11.8 ins. square forming a double dodecagon at each story, and connected to radial ties K also of wood, that join at the centre of the vault by c crossing. The three central vaults are each composed of 12 ro-round ribs with side arches, whose crowns are placed at the level of the central crown; the triangles between the 12 ribs are constructed in the usual manner. Thus each of the 12 bays being very narrow in comparison to the diameter of the vault, it results that the ribs carry only the walls radiating to ab-about two thirds of the vault, and that this central construction being very light, yet produces a powerful stiffening at the centre of the cylinder. There is no system of vaults but Gothic, that can offer such favorable arrangements, which it is necessary to recognize. From top to bottom, the work is constructed of cut stone 1.3 to 1.5 ft. high, whose surfaces are cut with straight edges, freely but perfectly dressed.

As the art of attack of places became more methodical, military structures were perfected, the materials employed were larger and better chosen, the walls thicker and better built, the masses filled with greater care and the mortar more uniform and hard. During the 13 th century, military structures were

executed with the greatest care, and the means of resistance opposed to attacks were remarkably extended. Men most frequently renounced surfaces of small stones or of common rubble during the 11 th and 12 th centuries; they were made of hard cut stone with tails long enough to not be easily torn out by the crowbars or pickaxes of the pioneers. In the masses are frequently found ties of stone and discharging arches embedded in the solid masonry. The parapets are composed of through stones, their external surfaces being admirably cut. Until about 1240 it frequently occurred that the courses were set on very thick beds of mortar (1.6 to 2.0 ins) fitted with bits of hard stone (147); but this procedure, that gave the beds of the c courses great adhesion because of the quantity of mortar used,[1] had the inconvenience of aiding the pioneers to insert crowbars between the courses to loosen the stones. On the contrary after that epoch, the beds forming the surfaces of fortifications are thin (about 0.4 in. and sometimes less), the edges of the stones are sharp without bevels, and their rough faces often form projecting bosses to conceal the chiseling of the beds and joints. (148). Indeed it was difficult to break out stones so surfaced, either by means of undermining or by the battering ram or all machines suited to batter the walls.

Note 1.p.270. It is necessary to remark here, that the mortar has greater cohesive strength when occurring in a great m mass, a very thin bed of mortar is burned (as the masons say) by the stone, and is then only a powdery and cracked layer w without adhesion, because in setting the stones these rapidly absorb the water contained in the mortar, so that this dries too quickly and loses its pr perties.

Under Philip the Bold and Philip the Fair, military structures returned to antique traditions. We have seen how the constructors of the castle of Enguerrand III at Coucy adopted f for the towers a thick external wall, and how internally they adopted arrangements sufficiently light to support the vaults or floors, thin piers forming between them small recesses with pointed vaults, thus they seemed to desire to harmonize t the needs of defense with the new methods of building of the lay architects of the beginning of the 13 th century. If in religious and civil structures these new principles, explained in the beginning of this Article, did not cease to advance and

to extend even the abuse and labored work, it was not the same in military structures; the architects returned to the simplest arrangements, and the more homogeneous system of construction. At each step we are then obliged to stop in the study of the art of building by the artists of the middle ages, and to resume a new path; for this logical art lends itself to all conditions, to all needs that appear, without ever attempting to impose a routine. At the moment when religious edifices excluded the round arch, and the art of construction abandoned itself to excessive research in churches, in military structures it finally returned to forms more serene, to the system of concrete and passive construction, so well developed by the Romans. In the fortifications of the city of Carcassonne built at the end of the 12 th and the beginning of the 13 th centuries, we have a striking example of this revolution.

As we have had occasion to present in this Dictionary a great part of the principal works and details of those fortifications,[1] we shall here limit ourselves to giving in its entirety and details one of the most important defenses of this enclosure, to show our readers what the art of military monstruction became under Philip the Bold. We shall select the principal tower of that enclosure, the tower called du Tresau, which yields in nothing to the finest antique structures that we k know. This tower defends one of the projections of the inner enclosure. It is constructed according to the system explained in our Fig. 142 (G), i.e., its two stories above the ground outside consist, on the side of attack, of niches between the internal buttresses, recesses at the bottoms of which are pierced slots that command the exterior. From one story to another, these niches alternate like those of the tower of the castle of Coucy. The ground in the city is 23.0 ft. above the external soil. Fig. 149 gives the plan of the tower du Tresau at the level of the ground story (cellar next the city), on a level with the external soil. Beneath that story exists a cellar cut in the rock, fined with masonry and vaulted, to w which one descends by the screw stairs placed in the angle at the right of the tower. The second story (150) is raised several steps above the ground in the city. This ground story and the second story (ground story next the city) are vaulted by means of transverse, side and diagonal arches, all by the Go-

Gotnic method. The second story (Fig. 150) has a fireplace G, a door opening on the tower of the city, a closet E for the cniet of the post and privies F corbelled out. The third story (second next the city) (151) has solid external walls in order to strongly load and connect together the lower construction, whose circular wall is pierced by alternated niches and slots; that story is covered by a floor. The fourth story (152) preeents a defensive gallery A open to the sky, at the centre being a hall beneath the roof, lighted by two windows opened in the gable wall D. Besides the stairs B that ascend from the bottom, there is found at the end of the defensive gallery a second stairs B'; both ascend to the summit of two watch towers, that flank the gate D. Placing the back against the gable wall on the floor of the ground story (plan, Fig. 149), and looking toward the side for defense, we see (153) the internal constructions of tnis tower. We assume the vault separating the ground and second stories to be demolished, in order to understand the arrangement of the internal nichef,f forming slots, alternating solids aver voids to cover all points of the external circumference, thus cutting the piers and avoiding vertical ruptures, according to the system adopted for the towers of Coucy, explained above. The simplicity of this construction, its solidity, the care with which its surfaces are jointed with fine cut stones internally and externally, indicating fully the attention that the architects of the end of the 13 th century gave to the execution of these structures, how they sacrificed everything to the needs of the defense, and how they knew how to subject their methods to the different sorts of construction.

In passing around the fortifications built about the city of C.rcassonne under Philip the Bold, one would scarcely suppose that a few years later was erected in the same city the choir of the church of S. Nazaire, several parts of which have been presented to our readers.

The tower du Tresau is covered by a steep roof forming a conical hip on the side next the country, and that on the side toward the city adjoins the gable pierced by windows lighting the different stories. If we make a transverse section of the tower looking toward the gable, we shall obtain Fig. 154. Examioing the plans, one sees that this gable wall is n

not very thick, compared with its height. But at this side it as only necessary to close the gorge of the tower, and besides this tower is stably maintained in the vertical plane by the two watch towers F F, that by their foundations and weight present two points of support with great stability. The junction of the covering and the gable is well sheltered by those steps forming spaces on the internal surface, and that facilitate an oversight of the upper parts of the tower. The roof(whose slope is indicated by the dotted line I K) rests on the two large eave walls K, entirely separating the defensive gallery from the interior of the central hall. At the level of the rampart, the defensive gallery G surrounds the structure at the side n next the city, as that of the outside is at A B.

Besides, the care devoted to the general conceptions of these two military edifices is manifested in even the least details. One finds everywhere the evidence of reflecting observation and of consummate experience. Thus without enlarging too much on the details that find their places in the Articles of the Dictionary, we shall limit ourselves to pointing out one of the internal arrangements of the structure of the fortifications of carcassonne at the end of the 13 th century. Some of these towers most exposed to the efforts of the assailants, at their fronts are finished with projecting angles designed to keep the pioneers away and to offer a powerful resistance to the blows of the battering ram. (Arts. Architecture Militaire; Tour). Now in this particular case, how is the jointing of the courese arranged (155). The joints of the stones in the front part of the tower are not drawn normal to the curve, b but at 15° degrees from the axis A B; thus the effect of the ram on the projecting angle, the narrowest part (consequently most easily attacked) is neutralized by the direction of those joints, that transfers the blow to the points joining the tower with the adjacent curtains. If the besieger undermines, a after excavating beneath the angle and even beyond it, he finds joints in the stone not leading toward the centre of the tower, compelling long and difficult labor, for it is necessary for him to remove with crowbar each block, that is obliquely presented, and he cannot disjoint them as easily as if they were cut in wedge shape. In our Fig. we have traced the jointing of two courses by full and by dotted lines.

While the religious and civil architecture adopts superfluous ornaments, so that the construction becomes more labored during the 14 th and 15 th centuries, military construction on the contrary daily employs the safest methods, the simplest means and procedures with the greatest resistance. The military structures of the end of the 14 th and beginning of the 15 th centuries everywhere adopted the round and segmental arches; the jointing is done with particular care; the concrete masonry is excellent and well treated, which is rare in religious structures. All causes of useless expense are avoided. Thus for example, the arches of vaults, that in the 13 th and even the 14 th centuries sprung from corbels, penetrate the surfaces as indicated in Fig. 156.[1] The springing of the pointed arch is cut in the facing courses of the tower. There are no side arches; this member justly seems superfluous. The first voussoir A of the filling of the vaults itself belongs to the facing; a simple recess cut in the facing receives the other stones forming the triangles between the arches. At the same time that all the details of the construction become simpler, and less expensive in execution, the jointing is perfected, the materials are better chosen for the places they occupy; the surfaces are dressed with extreme care even in the foundations, for it is necessary to leave opportunity nowhere for the work of the miner. If built on the rock, that is levelled with all the perfection given to the beds of coursed stone; if there are roughnesses and cavities in the rock, these are filled by good courses. One recognizes at all points this oversight and attention, that scrupulosity, which are for the builders the most evident sign of a very perfect art and method followed.

Note 1.p.278. From the towers of the castle of Pierrefonds, beginning of 15 th century.

Artillery came to arrest the architects at the moment when they had carried as far as possible the study and practice of military construction. Before it these refinements of defense became useless; it was necessary to oppose to this new means of destruction enormous masses of masonry or embankments. Cannon, by overthrowing those covered parapets and those well arranged machicolations, dismantling the ramparts and undermining their bases, no longer permitted the use of these ingeni-

ingenious combinations made to resist near attacks. Yet such was the strength of many strong places in the 14 th and 15 th centuries, that regular sieges were often necessary to breach and reduce them. In order not to extend farther this Article, already very long, we refer our readers for the study of the details of fortification in the middle ages to Arts. Architecture Militaire, Boulevard, Chateau, Courtine, Creneau, Donjon, Echauguette, Machicoulis, Porte, Siege, Tour.

CONTRE-COURBE. Ogee. Reverse Curve.

This name is given today to the reversed curves that terminate a pointed arch at its top. Ogee curves form the upper part of a recurved arch. (Art. Accolade). During the 14 th century appear ogee curves at the top of acute arches. At first they have little importance, then the gradually develop and become one of the richest motives of Gothic architecture in its decline. These ogee curves are already seen to surmount the archivolts of the windows lighting the chapels at the North of the cathedral of Amiens, and those chapels date from 1375.

Let us see how these recurves are traced; as a general rule reverse curves assume much less importance as the arches are curved at A and B; this is the perfect equilateral arch; in this case the reverse curve rarely starts except at one fifth the curve at D. Drawing the lene from B to D and extending it to intersect the axis O X of the arch, then the second line A D also prolonged, a perpendicular is erected at the middle of the line D E. The intersection of this perpendicular with the line A D prolonged gives the point F, the centre of one reverse curve, that then touches at the point E. If the arch be less pointed and its centres are placed at points G, which divide the base of this arch into three parts, each curve will be divided in four parts, and the beginning of the reverse curve will be at H. Proceed as before by drawing a line I H prolonged to intersect the axis O X, then a second line G H prolonged; erect a perpendicular at the middle of the line H K, and the intersection of this perpendicular with the line G H prolonged will give at L the centre of the reverse curve. If the arch be round or segmental, as frequently occurs at the beginning of the 1_ th century (sketch P), the reverse curve will start at R, half the quadrant S T, and employing

the same method, one will obtain that reverse curve R V. The profile of the archivolt being U U', the operation must be m made at the edge Z of the projecting member of this archivolt; one will thus obtain the trace Y, so that the different membe-rs a of the mouldings may have their reverse curve intersecting the master curve. As for the space B, it is usually not c cut deeper than the face d of the wall, and it is decorated by ornaments, reliefs, or remains flat; the projecting member alone of the archivolt forms the reverse curve. In the 16 th century are frequently found archivolts with broken reverse curves as indicated in sketch Q, the radii g n, i R being equal. These are abuses of Gothic art, which have been justly rejected by the architects of the Renaissance, and it must be stated, that nearly always by these abuses do men wish to judge that art, which certainly could avoid labored works, so cu much the less motived, because they oppose the jointing and trouble the constructor. But the architects of the last epoch of Gothic architecture were gradually led to surmount the broken arches of this useless member by the increasing predominance of the vertical line over the horizontal line. The broken arches themselves seem to oppose by their curve terminated at top the ascending lines of the edifice; it was necessary f for these arches to reach the vertical line, like all parts of the architecture. One is always disposed to indulgence for artists, who although in a false path, atone for the vice of the principle by perfect execution and a certain taste in details. This is what occurs when one examines our edifices of the end of the 15 th century. Without approving the abuses i into which they fell, the labor in the combination of forms, one is often seduced by the charm that they knew how to display in the infinite details of these combinations. The artists of Ile-de-France were the only ones, who at that epoch of decadence were marked by refined taste, even in their errors. A And to mention here only the reverse curves surmounting archivolts, we see in that privileged province them give to that singular innovation in forms relative proportions, that one cannot find elsewhere. They avoid applying reverse curves to great archivolts, which always has a heavy and ungraceful effect; they trace them only above secondary arches, and frequently disguise their sharpness by rectifying a little the cu-

curve produced by the compasses. It will suffice us to give an example to emphasize this observation. In the court of the charming mansion de la Tremouille, that we saw demolished in 1341 (not without regret for that destruction was an act of useless vandalism, and which it would have been easy to avoid), there existed a turret whose projecting portion was borne by two columns.[1] An archivolt surmounted these two points of support, and this was cut in a reverse curve.(See Fig. 2, opposite). One sees that the architect traced the reverse curves, not merely by two lines with the compasses, but rectifying t the sharpness, as we have just said. This archivolt has only about 3.3 ft. opening, and is not cut in voussoirs; its upper part is taken in a single course resting on two imposts. Thus this is merely a decoration, and the reverse curves skilfully connect the apex of the arch with the numerous vertical members by which the turret is finished from top to bottom. It is the same with this example as with every work of art; everyone can know the rule, but it is only artists of taste, who know how to apply it properly. In the numerous monuments of the 15 th century that cover France and Germany, reverse curves are rarely drawn with rufficient refinement; their beginnings are placed too low or too high, crushing the lower arch or do not join its branches. Let us add that reverse curves never produce a good effect,when they surround arches of small diameter.

Note 1.p.283. Some fragments of this mansion are now deposited in the front court of the Ecole des Beaux Arts.

CONTREFICHE. Brace. Strut.

An inclined member of carpentry, whose function is to serve as a shore in carpentry. The member A (1) is a brace. (Art. Charpente).

CONTRE-FORT. Buttress.

This is a reinforcement of the masonry built at a load or t thrust. It is unnecessary to explain here the function of the buttress, for that function is fully developed in Art. Construction. We shall restrict ourselves to mentioning the different visible forms given to buttresses in religious and civil edifices, and the transformations, that this architectural m member suffered from the 10 th to the 16 th centuries.

The Romans having adopted the cross vault in their edifices must necessarily seek means to resist the effect of the thrust of these vaults. They found these resistant masses in the combination of the plan of the edifices, which one can recognize in visiting the halls of the baths, and particularly the edifice known at Rome ander the name of the basilica of Constantine. But when the barbarians took possession of the last traditions of the art of construction left by the Romans, they found No artists sufficiently learned or enlightened to understand what was wise and reasoned in the plans of the vaulted edifices of Roman antiquity; seeking to imitate the plans of the Latin basilicas, desiring at first to vault the side aisles, they were necessarily forced to resist externally the thrust of these vaults by reinforcements of masonry, to which they first gave the appearance of engaged columns or of h half cyliyders, then soon that of square piers extending up to the cornices.

Among the oldest buttresses of the middle ages may be cited those supporting the walls of church S. Remy of Rheims (10 th century). These are half cylinders (1), stiffening the walls of the side aisles at the points of the thrusts of the vaults, and the walls of the central nave at the trusses of carpentry; for then that created a nave that was not vaulted. These primitive buttresses are only crowned by cones or by capitals, t that often support nothing. The cylindrical form was abandoned in the North for buttresses, while that form persisted in the W West till the middle of the 12 th century. Still may be seen in Beauvoisois a number of churches or monastic edifices, that adopted the rectangular form for buttresses, very broad at t the base and quite narrow at the top, so as to not exceed the projection of the cornice. We give here an example of them taken from a little church of Allone, whose chevet appears to have been erected about the end of the 11 th century.(2).

These buttresses resisted thrusts of the cross vaults, and they are composed so as to be able to form a square return, as indicated by the plan A. Their top,which is no more than a p pilarter with about 3 ins. projection, is terminated by a sculptured ornament B, slightly representing a capital on which rests the slab serving as a cornice. Yet the primitive rectangular buttress with small projection is generally crowned a

and nave bases, as indicated by Fig. 3, in Ile-de-France, Champagne, Burgundy and Normandy; but in the last province from the 11 th century, they are frequently composed of two or three parts distinguishing that section, while in elevation they rise from the base without side projections; such are the buttresses that flank the facade of the abbey church of S. E Etienne at Caen (4). Besides, contrary to the Burgundian method and that of Champagne, these old Norman buttresses in monumental construction are erected in low regular courses of t the same height as those forming the facings of walls, and a are perfectly connected with them. But in structures built w with economy and only having walls of plastered rubble, the N Norman buttresses are composed of unequal courses and often of slabs set on edge. Then sometimes the windows lighting interiors are opened,even on the axes of the buttresses; that is one means of avoiding the furnishing of cut stone required to form the jambs and archivolts of those windows, if they w were pierced between the buttresses. It is understood that t these openings made in the middle of the piers can only belong to edifices not vaulted but covered by carpentry ceilings.

We know several examples of this singular arrangement, one in the Church of S. Laurent near Falacis (5), the other in th that of Montgaroult (6), a third at Ecajeul near Mezidon.[1]

Note 1.p.287. These two drawings were furnished to us by M. Ruprich Robert, to whom we owe an excellent restoration of t the church of the Trinity at Caen.

We further givi in Art. Construction the procedures of jointing employed during the Romanesque epoch for flying buttreses and jointing them to the walls. We shall then only have to occupy ourselves here with the forms given to these points of support during the middle ages.

One will readily admit that the edifices, being very simple externally before the 12 th century, the buttresses must share in this simplicity, and that they must present very slight projections, since the walls themselves were very thick. Indeed they were then merely a vertical projectiug series of stone quoins, reinforcing the principal points of support, and they were terminated at top in the manner indicated in the preceding Figs., or they were covered by the slab of the cornice as in the sketch (7), not projecting beyond it. But when in the

12 th century the system of construction employed until then was modified by the lay school, so that this school, leaving Roman traditions aside, could apply systematically the principles of Gothic construction, the buttresses became the principal members of every vaulted edifice. The walls were no more than intended to enclose the naves, a sort of screens, adding nothing or little to the stability. Then on the exterior the buttresses themselves alone constituting the edifice covered by the masonry vaults, it was necessary to cause their function to oppose frankly, to give them the forms in accordance with this function, and to decorate them as much as any architectural member could be, that not only must be stable, but still retain the appearance of strength. Yet only by transitions the first Gothic architects arrived at giwing their buttresses the importance, that should be taken by structures of this kind. Their first attempts were timid; the traditions of Romanesque architecture had overthrown the remnant of influence, from which they could not withdray abruptly. It is clear that while desiring to adopt in the interior their new system of buttresses, they sought to retain on the exteriors of edifices the Romanesque appearance to which their eyes were accustomed, or that if by force the buttresses must present a very considerable projection from the face of the walls, they endeavored to recall in the mode of decorating them architectural forms, that rather belong to piers supporting a vertical load than to abutting piers. These attempts are evident in Beauvoisois, fruitful in vaulted edifices of that epoch of transition. We give two examples of these to our readers. The buttress(8) strengthens the wall of the side aisles of the nave of church of S. Etienne of Beauvais (12 th century); like all the masonry of the edifice, it is constructed of small materials, and the little upper columns appearing to support the cornice are built in courses bonded with the structure. The buttresses (9), projecting more than those of church S. Etienne, belong to the old collegiate church of S. Evremont at Creil (12 th century). It is here evident that the architect had no other idea for decorating this abutting pier, than to give it the appearance of a pilaster ornamented by capitals. Not knowing too well how to terminate this pier, he covered it by a stone slope decorated by scales imitating tiles. The system or orna-

ornamenting buttresses by little engaged columns at the angles , and intended to disquise the dryness, during the 12 th and 13 th centuries, belongs almost exclusively to the basins of the Oise and Aisne. But still one perceives that the architects of that province in the 12 th century, already very s skilful in the construction of vaults, were very much embarrassed to know how to harmonize the successive recessions, that must be given to the abutting piers for resisting the oblique thrusts of vaults with the appearance of vertical support retained for these piers. One recognizes the traces of these uncertainties in the angle buttresses of the south tower of church of S. Leu d'Esserent, a buttress of which we give the s superposed members (10).

With regard to these angle buttresses, it is here necessary to remark, that there is presented a difficulty to which the architects of the 12 th century did not give the most natural solution at first. If these buttresses abutted a tower, for example, whose walls because of their height must recede at e each story as indicated by Fig. 11, they did not know how to connect the tops of these buttresses with the point B, the a angle of the upper story of the tower; it was necessary for them to build the sides E F of these buttresses vertically a and to recess the sides G H to reach the point B, which produced a bad effect, the buttresses appearing to rise diagonally as shown by Fig. 10. To avoid that defect, the means was very simple; so after several experiments it was employed; this was (11 bis) to erect the buttresses in the internal and external surfaces of the upper story A B C, and to allow the projection in the angle K of the offsets of the lower stories of the walls. Henceforth this method was invariably followed by Gothic constructors.

On the walls of the church S. Martin of Laon, cited above, and whose erection dates from the middle of the 12 th century, one already sees buttresses designed with art and bonded well to the structure. The gable wall of the south transept of that church possesses angle buttresses, that skilfully recede, and a buttress placed on the axis beneath the rose window, so as to properly abut the wall. (Art. Pignon). The band beneath t the lower windows is carried around these buttresses, and serves as a first course of the slope of their second recession.

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Above this are the abacuses of the capitals of these same windows, that begin the third recession, wider on the face than at the sides, so as not to diminish too abruptly the width of these piers. The central abutment alone receives a third band connected with the archivolts of the second windows, while t the angle buttresses stop with a simple slope beneath this b band. With this freedom, that is one of the qualities of the architecture of the 12 th century at the moment when it left Romanesque traditions, the constructors of the church of S. Martin of Laon, having had the idea of placing in the transepts their square eastern chapels, and desiring to vault these transepts by two cross vaults only, must erect a buttress on the axis of the middle chapel. See how they proceeded to solve this problem; on the walls separating these chapels they built two buttresses A A (12), connected by an equilateral p pointed arch, then on the crown of that arch they built the buttress B designed to abut the transverse arch and the diagonal arches of the high vault. This arrangement permitted them to pierce a wendow under the buttress B, in order to light t the transeot over the entrance archivolt of the middle chapel. We still see on the exterior of the apse of the monastic church of S. Leu d'Esserent, a central chapel in two stories, wh whose upper buttresses rest on the archivolts of the lower windows. The weight of these buttresses is distributed over t the jambs and piers separating these windous. In the 13 th c century the architects senounced this alternation of solids and voids, and the buttresses rest on the ground; yet there w was not that mode of building and precious resources, in that it permitted the unequal division of the different stories of an edifice, which in many cases was required by the internal arrangement. Until the end of the 12 th century, men had not yet thought of increasing the stability of buttresses by means of an upper loading; but sought to make them stable by their mass and the area of their horizontal section. Yet we already see in the preceding example (Fig. 12), that the head of the buttress extends above the cornice of the edofice, and t that it is loaded by a pinnacle.[1] But when these constructors diminished the areas occupied by the points of support, they supplemented the weak horizontal section of these points of support by upper loads.

Note 1.p.228½.The actual pinnacle must have been rebuilt in the 14 th century, but it is evident that one existed in the 12 th century.

Before making known the successive advances of the construction of the buttresses during the 13 th century, we must mention certain varieties of that important member of architecture in the principal provinces. In Ile-de-Franc, Champagne and Normandy, the buttresses generally take the rectangular form, and they have from the Romanesque epoch the appearance proper for them, that of an abutting pier, a resistant mass. But in the provinces where Gallo-Roman traditions were retained until t the end of the 12 th century, as in Burgundy, Auvergne, Poitou, Saintonge, and Languedoc, the architects sought to give their buttresses the appearance of a Roman order, i.e., they composed them of one or more engaged columns surmounted by t their capitals and bearing the entablature, reduced to a simple moulded slab.

We see on the exterior of the apsidal chapels of the churches of Auvergne, a part of Guyenne, of Languedoc and of Poitou, buttresses composed after this system.(Art. Chapelle, Figs. 27, 33). In Burgundy, these buttresses frequently terminate w with a slope set on the capital, as shown in Fig. 13.[1] Even sometimes the buttresses of the 12 th century on the upper M Marne and along the Saone affect for their front face the form of Roman fluted pilasters imitated from the Corinthian order, as around the apse of the cathedral of Langres. The buttresses of the apsidal chapels of Notre Dame of Chalons-sur-Marne are only engaged fluted columns, whose capitals bear statuettes covered by canopies joined with the cornice. These t traditions were entirely rejected by the artists of the 13 th century. In the architecture of that epoch, and when Gothic art is frankly adopted, the buttress is a buttress and no longer attempts to conceal itself under a form borrowed from antique architecture. We have a remarkable example of the primitive Gothic buttress on the apse of the church of Vertheuil near Mantes. We give (15) the elevation of these buttresses, and their plan (15) at the height of the external passage that extends beneath the sills of the windows entirely around the chevet. It is not doubtful that here the architect desired to oppose to the curve of pressures produced by the arches of t

the vault an oblique abutment, resistant by its mass and by the section of its profile, composed of a succession of recessions, but that they had not yet thought of neutralizing the oblique thrust by an extra vertical load. They soon perceived that these repeated slopes were worn by rainwater falling in a cascade frome to the other: that it was not necessary to g give the buttres so great a depth, since the resultant of the thrusts acted only at their axes, and that it sufficed to ensure their stability by a depth proportioned to their height, considering them as portions of the walls. The buttresses of the apsidal chapels of the cathedral of Mans built about 1220, while retaining the principle adopted at Vetheuil, already p present a sensible improvement. These buttresses (16) recede above each slope, and then are crowned by gargoyles that cast water from the roof far outside the upper recessions. It must be stated, that these chapels were built on the slope of a precipice, and that it was necessary to give the buttresses a considerable base to maintain the structure, whose internal pavement is elevated about 16.4 ft. above the external soil. About the middle of the 13 th century, the architects definitely rejected the slope; they raised their buttresses vertically at the sides, except a slope at the base, having recessions of an inch or so on their outer face above each bond or drip that protected the surfaces of these faces at different heights. Thus are constructed the buttresses of S. Chapelle of the Palace at Paris, and those of the apsidal chapels of t the cathedral of Amiens. (Art. Chapelle, Figs. 3, 40). The buttresses thus retaining at their tops a projection nearly equal to that of their plan at the level of the ground, men had the idea of crowning them by a cornice that served as a gutter, and of placing gargoyles at the projecting angles of this cornice or the middle if each drip moulding, which in t that position casts the rainwater far from the surfaces. Above the cornice were raised pinnacles, that by their weight increased the stability of the buttresses. The construction gradually becomes lighter at the end of the 13 th century, t the architects constantly seeking means of diminishing the v volume of materials while preserving the stability of their structure by vertical loads, then often built these buttresses only to the point of thrust of the vaults, and on these

engaged piers they placed pinnacles detached from the construction having no effect other than to load the abutting portion of the piers. One finds one of the best examples of this sort of construction around the apsidal chapels of the cathedral of Seez.(End of 13 th century).(17). The thrust of the vaults does not act above the level A. There the buttress ends in a gablet, and ceases to be connected to the angle of t the chapel; astride the gablet rises a detached pinnacle B, o only connected to the structure by the gargoyle that crosses it and by the block C that serves as a balustrade. Thus the pinnacle loads the butthesses, serves as support of the gargoyle, maintains the projecting angle of the balustrade, has n not the heavy appearance of a buttress rising at once to the cornice, and serves as a transition between the lower massive parts and the lightness of the crowning parts, by giving strength to the projecting angles of the chapels.

Note 1.p.295. Of the obedience of S. Jean-les-Bons-Hommes near Avallon.(Architecture Monastique, Fig. 12; 12 th century). Here the slope that terminates the capital is cut in a single stone.

About the middle of the 13 th century in religious edifices and vaulted halls, the architects had adopted the method of entirely suppressing the walls, and of opening under the side arches of the vaults, windows that occupied the internal surfaces left between two buttresses.(Arts. Architecture Religious; Construction). This arrangement produced by the system of construction that tended more to transfer the load to the buttresses, gave a very rich appearance to the exterior of the edifices by accompanying with tracery windows in all spaces left free, but emphasized the more the nakedness of the external piers, which it was essential to give great solidity. The architects were then led to decorate also the buttresses so as not to present an offensive contrast between the lightness of the windows and the heaviness of the piers. Thus at the beginning of the 13 th century we already see the buttresses of t the cathedral of Chartres decorated by niches with statues. This ornamentation was at first timid, enclosed within the o outline of the structure, but developed rapidly; it was combined with the upper pinnacles as around the nave of the cathedral of Rheims (Art. Pinnacle), also as on the western facade

of the great hall of the synod of Sens (Art. Salle) about 1240. Yet until the 15 th century the buttresses retained the appearance of strength and stability that is proper for them; during the 14 th century itself, it seems that the architects ceased to decorate their fronts; they contented themselves w with surmounting them by very high and very rich pinnacles, as around the chapels of the cathedral of Paris. But let us not forget that the 14 th century, which frequently falls into excess of lightness, is generally sober in sculpture. Among the most richly ornamented buttresses of the end of the 13 th century and beginning of the 14 th may be cited here those of t the choir of S. Urban of Troyes. The decoration of these buttresses always consists only of a facing of stones set on edge, superposed and fixed by cramps to the piers built of courses. (Art. Construction, Fig. 103). This system of ornamental facings, much used in the 13 th century, was entirely abandoned by the architects, who were first skilful builders, and l left but a small space for the imagination of the artist.

About the end of the 14 th century, they commenced to modify the facings of the buttresses, which until then had retained their surfaces parallel and perpendicular to the face of the wall; they sought to disguise the rigidity of their angles, to diminish the obscurity produced by their strong projections, by setting their courses diagonally as indicated in Fig. 18. By means of the cut-off angles A B were obtained more space, the windows placed between them were less masked and received more light from outside. The two intersecting squares with edge in front permitted a superposition of pyramids with a v very happy effect. These exist very pretty buttresses built on this system along the chapels of the nave of the cathedral of Evreux. (19). The Gothic epoch in its decline only loaded with details these essential members of the architecture, to the point of removing their character of strengthening piers. Their horizontal sections only present strange complications of curves and of squares intersecting, leaving niches for statuettes and forming corbels to support them; all that was d drawn and cut with science and extraordinary perfection, but presenting to the eyes only confusion, after so many efforts and difficulties in execution. Whoever desires to consider, for example, the great buttresses that strengthen the western

facade of the cathedral of Rouen, and that were built at the beginning of the 16 th century under cardinal of Amboise, can pass an entire month in drawing their plans, in understanding the intersections of the hundreds of prisms that compose them; yet this labor and research only produce a disagreeable effect in execution.

The buttresses of the 15 th century and beginning of the 16 th are generally composed of a body with two faces intersecting at angles of 45° degrees. Thus the base is square, presenting one face parallel and two perpendicular to this wall. E Above the first offset the square presents an angle instead of one of its sides in front; the two diagonal sides ane then flanked up to a certain height by two additions with square bases, the sides parallel to the original sides and forming prisms terminated by pyramids; above the buttresses present an angle that bears gablets, then its pinnacle. The plan (20) gives the horizontal section of this sort of buttresses, and the elevation (21) their appearance. This pinnacle is applied with distressing monotony during the last times of Gothic architecture. Sometimes these squares have their sides set parallel or dragonel to the surfaces, are again subdivided and in hollowed out in niches, covered by a more or less great number of mouldings; but the principle is always the same. (Arts. Pinacle, Trait). Again in Ile-de-France the abuse of these i intersections is less frequent, and until the last efforts of Gothic one meets with refined taste; that is fect among the architects a sort of repulsion for exaggerations.

The pretty mansion de la Tremoille at Paris, whose demolition is to be regretted forever, and that was built in the first years of the 16 th century, in the midst of the luxury of the architecture of that epoch, retained that sobriety in the details and that reason in the composition without which every architectural work wearies the eyes. A vaulted portico open to the court, extended along the building next the street. These vaults rested on slender piers strengthened by projecting ribs taking the places of buttresses, and giving area to those piers.[1] The archivolts of the porticos penetrated the oblique sides of the buttresses, so as to connect the courses with the vertical points of support. At the mansion de la T Tremoille are not found those loads by canopies, corbels, int-

intersections of prisms, that give an edifice the appearance of goldsmith's work made to be minutely examined near by. The construction of that habitation was so well understood, that in spite of the extreme lightness of the piers and the thrust of the vaults, nothing had moved; still when the demolition occurred no iron ties were found at the level of the second s story. It is unnecessary to state, that at the level of the imposts of the arches of the vaults had not been placed, as in the porticos of Italian architecture, those horizontal bars of iron, that so brutally emphasize the weakness of the constructors.

Note 1.p.304. See Arch. civ. et dom. of MM. Verdier and Cattois. Plate 2.

The Renaissance evidently found itself greatly embarrassed, when necessity compelled it to place buttresses on the exteriors of edifices to resist thrusts. It imagined nothing better than to decorate them by pilasters or columns borrowed from Roman art. Sometimes, as in the court of the old chateau of S. Germain-en-Laye, it connected them at the different stories o of the structure by arches forming a gallery or balconies; but that was again a Gothic tradition, whose origin we shall indicate in our Art. Construction, Fig. 120. It did not faid to disappear like the others, and when it was absolutely necessary to establish buttresses before the facades of religious or civil buildings, they superposed Roman orders over each o other. If thes singular application of the antique orders produced a grand effect (which we refrain from deciding, since this is a matter of taste), it had as result the disguising of the true function of the buttress; as construction that of c causeng useless expense and of placing several cornices above each other; now these repeated cornices have the inconvenience of stopping rainwater and causing dampness to enter the masonry. But let us not forget that the important matter for architects from the end of the 16 th century, was to seek pretexts for placing columns, no matter how. Everyone desired to have erected one or several orders, and everybody found thna very beautiful. From the instant that in architecture one abandons rules imposed by good sense and reason, we confess that to us it m matters very little whether the forms adopted are borrowed from Roman or Gothic. They ended by regarding the buttress as a

confession of weakness, and by suppressing it in modern structures, but as it is necessary that masonry should stand upright, that thrusts should be abutted, and that the overthrow o or buckling of the walls should be arrested in vast buildings, men have adopted the system of giving the walls the thickness, that should only be given to some isolated piers, in brief to buttresses. Masonry being estimated by volume and work, thus they pay very dear for the pleasure of saying and repeating that the Gothic constructors were barbarous; and what is pleasant is to hear said very seriously to those paying for those great useless walls, that buttresses indicate the ignorance of the constructors.

COQ. Cock. Weathercock.

William Durand,[1] in his Rational des divin offices, expresses himself thus with regard to the weathercock surmounting the highest point of the church in the West.

Note 1.p.305. Rational. Vol. 1.chap.1. sect. 22.

"The weathercock placed on the church is the image of the preachers, for the cock wakes in the dark night, marks the hours by his song, arouses those that sleep, and celebrates the appearing day, but at first he wakes and excites himself to sing by beating his sides with his wings. All these things are not without a mystery, for the night is this age; those that sleep are the sons of this night, resting in their iniquities; the cock represents the preachers that preach with a loud voice and awake those that sleep, that they may reject the works of darkness, and they cry: 'Woe to those that slumber! Arise thou that sleepest!' They announce the light to c come, when they preach the day of judgment and the future glory; but filled with prudence, before preaching to others of the virtues, they arouse themselves from the sleep of sin and chastize their own bodies. The apostle himself is a witness of this, when he says; 'I chastize my body and reduce it to servitude, fearing that by chance after having preached to others, I may myself come to be reproved.' And like the weathercock, the preachers turn against the wind, when they strongly resist those that revolt against God, by rebuking them and c convincing them of their crimes, from the fear that they may be accused of having fled at the approach of the wolf. The i

iron rod on which the weathercock is fixed represents the inflexible word of the preacher, and shows that he should not speak of the spirit of man but of that of God, according to this word; 'If one speaks, that this is the speech of God.' And because this rod itself is paleced above the cross or the ridge of the church, that signifies that the scriptures are completed and confirmed."

Thus in the 13 th century it was well understood that the cock placed at the summit sf towers was a symbol; purther it is clear that this cock was moveable and served as a weathercock. But before that epoch there is a question of cocks placed on the spires of churches. The Bayeux tapestry, that at least dates from the beginning of the 12 th century, shows us a cock on the abbey church of Westminster, and contrary to m modern customs, that cock has its wengs spread.[1]

Note 1.p.306. We refer our readers to the learned dissertation of M. Barraud on those cocks of churches.(Bull. mon. Vol. 16. p. 277.

Walston, a 10 th century author, in the book of the life of S. Swithin, speaks in a very poetic manner of the cock placed at the apex of the church that bishop Elfege had built at Winchester.[2]

Note 2.p.306. We borrow this translation from the review of M. Barraud.

"A cock of elegant form and all resplendent in the gleam of gold, occupies the summit of the tower; he looks on the earth from on high, he dominates att the country. Before him are p presented the shining stars of the North and the numerous constellations of the zodiac. Beneath his proud feet he holds t the sceptre of command, and he sees below him all the people of Winchester. Other cocks are humble subjects of him, that they see thus floating in the midst of the air, and commanding with pride all the West; he faces the winds that bring rain, and rotating himself he boldly presents his head. The terrible efforts of the tempest do not disturb him, he receives with c courage both the snow and the force of the hurricane, he alone sees the sun at the end of its course and sinking into the ocean, and it is given to him to salute the first rays of aurora. The traveler that perceives him afar fixes his eyes on him; without thinking of the distance still to be passed, he advan-

advances with new ardor. Although the may really be very far from the end, his eyes persuade him that he is near it."

This symbol of vigilance, of struggle against the force of the wind, paledd at the highest point of religious edifices, belongs to the West. There is no question of cocks placed on the towers of the churches of southern Italy. Would it be for this that they have been removed from most of our churches? Or at least that they have not generally been replaced, when these have rusted?

We have found no colks on towers of an old epoch, or those that we have seen were of rude design and work, that we do n not believe it necessary to reproduce them here. We can only desire cocks to resume their old places; were it on as weathervanes, they have their utility.

CORBEAU. Corbel. Bracket. Console.

A support of stone or wood projecting from the face of the wall, having its front moulded or carved, presenting two plain sides, and receiving either a cornice slab, a band, the i impose of the vault, a corbelled pier, the lintel of the duurway, or the main beam, etc. The actual origin of the corbel is given by the projection of a wooden beam beyond the face of a wall, as indicated by Fig. 1, a projection arranged to support corbelled half timber work, a roof, post, etc.

During the late empire, the Romans had adopted corbels of stone or marble to support small orders of architecture projecting from the walls, crownings of openings, piers, or even cornice slabs and bands. The architects of the Romanesque epoch adopted this member and were satisfied to employ it as an ornamental detail, but they used it so well that it became one of the most common means of construction during the 11 th and 12 th centuries. In their turn the architects of the Gothic e epoch employed it in a great number of cases with success. Wo Wooden construction was long accepted by the barbarian masters of Gaul, and when they could erect edifices of masonry, they retained for certain architectural forms the forms given by carpentry; only they imitated those forms in stone. The oldest corbels always took the form of the end of a beam or joist, ornamented by mouldings or sculpture; such are the corbels that one sees in the nave of the church of S. Venoux near Voul-

Moulins (9 th or 10 th century), and that support a slab originally receiving a ceiling of carpentry. (2). Below this cornice, between the archivolts of the side aisles the verticals of the columns are also seen corbels carved in the form of human heads (3), which were probably intended to receive the f feet of anchors relieving the tiebeams of the carpentry. The statuaries of the 10 th, 11 th and 12 th centuries appear to have taken the stone corbels as one of the motives most suitable for sculpture. They decorated them by figures of men and of criminals, heads, symbolical subjects, such as the vices and virtues, the signs of the zodiac, the labors of the year; they strove to vary them. Particularly in Auvergne, Berry, n Poitou, Bourbonnais and along the Garonne, one finds on the edifices of the romanesque epoch a prodigious number of corbels of remarkable execution, dating from the end of the 11 th century . These corbels are nearly always intended to support cornice slabs or bands.

Although vaults were very early adopted in the edifices of A Auvergne, yet the tradition of coverings in carpentry made i itself felt by the presence of corbels, that were retained u under cornice slabs until the end of the 12 th century. The church of Notre Dame du Port at Clermont, that of S. Etienne of Nevers, possess cornices with ornamental corbels very interesting to observe. Most assume the form given by Fig. 4. T This is evidently an imitation of the end of a dresses beam. These volutes accompany the principal rib and are nothing more than the shavings produced by the hand of the carpenter to clear the rib at the middle. It suffices to know how the work- with the adze can cut away the end of the beam and reserve t there a bracket, to recognize that these volutes represent t the shavings produced by the work of the carpenter. A figure (5) will make our explanation intelligible to all. Take a beam at the end of which is to be arranged a bracket A. The workman will remove with his adze a series of thin chips so as not to split his timber; then he will cut off those at their base, if he desires to entirely clear the bracket. Seeing that these chips form an ornament, he had the primitive idea to not cut them off, and beams have been so set. Later that ornamentation, produced by the mode of execution employed by the workman, was carved in stone. In this manner most of the ornaments of arch-

architecture, which are not imitated from the plant kingdom, originate in the most natural means of execution.

If one desires to seek the origin of art forms of a conventional art like architecture, it is necessary to resort to practical means that remain the same for centuries, and to resolve to study those practical means, without which he will make many errors. Gradually instead of the modern bracket strengthening the end of the beam, and leaving it there so as to lighten it, he carved animals and heads, the lateral shavings lost their importance, but traces of them are still found at the sides.

Thus were carved most of the corbels of the abbey church of S. Sernin of Toulouse, which date from the 12 th century, and that have a singular energy of design. Here is one taken from the cornice of the south gate. (6).

The shavings disappeared completely about the middle of the 12 th century, as we have the proof in examining the cornice of the apse of the little church of Mas d'Agen (7).

The corbels remain beneath the cornice slab of the edifices of Poitou, Saintonge and Berry, until during the first years of the 13 th century. The beautiful arcade that closes the side aisle of the nave of the cathedral of Poitiers (1190 to 1210) is surrounded by a cornice, whose cornice forms a gallery and is supported by charming corbels ornamented by figures (8).

Stone corbels disappear from cornices during the 13 th century, and are rarely employed longer except as unusual supports of balconies, corbellings, tiebeams of carpentry or the main beams of floors.

Here (9) is a rich corbel found near the cathedral of Troyes, which dates from the beginning of the 13 th century and appears to have been intended to support a strong projection, for example like that of a balcony or the main beam of a floor. Then frequently in civil or military edifices are found strong stone corbels composed of several courses and exactly performing the function of an anchor of the carpentry under a main beam. Such are the corbels still in place in the high walls of gate Narbonne at Carcassonne (end of 13 th century), and that support the enormous thickness of the roofs of the two towers (10). The constructor certainly had here the idea of

placing this stone member in accord with the wooden timber s supported.

The hall of arms of the city of Ghent in Belgium has retained analogous corbels beneath its main beams (11), but much ri richer and exactly representing a tie resting on a corbel A fixed in the wall, bearing beneath the beam a cap B, just as would be practised in a carpentry work.

These rigid forms are rare in the 15 th century, and corbels intended to support beams are rich in sculpture, frequently ornamented by figures and reraldic shields, but no longer retaining the appearance of a wooden timber, inclined or horizo- ontal and fixed in the wall. Such are the corbels of the great halls of the castles of Coucy and of Pirrefonds (12), that s support the tiebeams of the carpentry.

The machicolations common on the military works of the 14 th and 15 th centuries are supported by corbels composed of t three or four corbelled courses. (Art. Machicoulis).

From the Romanesque epoch until the 16 th century, the stone lintels of the doorways are generally relieved by corbels projecting from the jambs, so as to diminish the span and consequently the chances of rupture. When doorways have great importance in location and purpose, these corbels are decorated by very rich sculptures and are executed with particular care, for they always are placed near the eye. There exists under the lintel of the south gate of the nave of the church S. Sernin at Toulouse two corbels of white marble. We give one (13) of them, which represents king David seated on two lions; traces of the side shavings again appear here in the form of a simple festoon. This sculpture belongs to the beginning of t the 12 th century. The lintels of the principal doorways of our great churches of the 13 th century are always supported by corbels wit extremely labored sculpture. We shall cite t those of the doorways of the cathedral of Paris, of the north doorway of the church of S. Denis, and those of the cathedral of Rheims and of Amiens. Architects have generally caused the sculpture on these corbels of portals, of figures connected with the subjects placed on the jambs or the lintels.

Burgundy, so rich in fine materials, presents an extraordinary variety of corbels, and these affect forms that belong to that province. Without mentioning corbels frequently employed

in cornices (Art. Corniche), those supporting lintels of doorways have a very remarkable character of strength. They are sometimes strengthened at the middle to oppose greater resistance to a pressure. We give (14) one of those corbels of the end of the 12 th century, that comes from the western doorway of the church of Montreale. later their mouldings are still more accented, as shown by Fig. 15.. (Corbel from one of the doorways of the side aisle of the choir of the cathedral of Auxerre, 13 th century).

In the 12 th century the arches of vaults are often supported by corbels. During that period of transition, it occurred that the constructors, according to the Romanesque system only built engaged columns to bear the archivolts of the transverse arches, and desiring to turn the diagonal arches to receive the triangles of the vaults, when the piers were erected, they no longer found a proper bearing to receive the imposts of these diagonal arches; then above the capitals of the transverse arches they set a corbel, that served as a starting point for the diagonal arches. Thus were constructed the vaults of the side aisles of the nave of church Notre Dame of Chalons, (16), and those of the side aisles of the cathedral of Sens. In the church of Montreal just cited, to not embarras the sanctuary by engaged piers resting on the floor, the architect has not only supported the diagonal arches, but also the transverse arch supporting the two vaults covering the rectangular apse, on strong corbels deeply engaged in the construction. (17). In this figure is seen at A the wooden tiebeam set to resist the thrust of the arches during erection, and cut off, flush with the impost when that construction was sufficiently loaded.

In the 13 th century, when vaults are not supported from the pavement, they no longer rest on corbels but on consoles.(Art. Cul-de-Lampe). The stone corbel almost exclusively belongs to the Romanesque epoch, the 12 th and beginning of the 13 th centuries. As for the wooden corbels, i.e., the projections formed by the beams or joists from the face of the wall, it is found in all wooden structures until the epoch of the Renaissance. (Arts. Charpente, Maison, Pan-de-Bois, Solive).

CORBEILLE. Bell of Capital.

CORBEILLE. Bell of Capital. Basket.

Generating form of the capital around which are grouped ornaments, foliage or figures that decorate it. At bottom the b bell rests on astragal and it is surmounted by the abacus. (Art. Chapiteau).

CORDON. Band. Fillet.

Moulding composed of a single member extending horizontally on a vertical wall. It does not have the importance of the b belt, which always indicates a level of the structure, for example, a floor or a story. The band is an intermediate member, whose place is only indicated by taste, so as to remove the nudity of too high vertical parts. Bands are only found in Romanesque architecture, for in Gothic architecture all horizontal courses forming a projection always have a real signification, and indicate a floor or level.

CORNICE. Cornice.

The crowning member of a structure of stone or wood and intended to receive the base of the roof. The cornice is one of the architectural members of the middle ages, that best indicates how mucr the principles of that architecture differ from those adopted by the Renaissance.

In Roman architecture the cornice belongs to the entablature, which itself belongs to the order, so that if the Romans superposed several orders in the height of a monument, they had as many entablatures as orders. Thus the edifice consisted of several superposed orders, as merely a scaffolding of edifices placed on each other. Further, if the Roman placed an order in the interior of a hall, he left it its entablature, i.e., its crowning member intended to receive the roof. That may produce a grand effect, but cannot satisfy the reason. Besides, in the Roman orders, which are derived from the Greek orders, the entablature by the form of its mouldings, its projection and the appendages accompanying it, clearly indicates the presence of a gutter, i.e., the base of a roof and the l longitudinal channel receiving the rainwater running down the surface of this roof. What is the good of a gutter at mid-height of a wall, particularly ou the interior of a ceiled or vaulted hall? They why the cornice? We have stated elsewhere

now the Roman was little disposed to reason on the enclosure of the decoration of his edifices.[1] We do not make this a reproach to them, but only state the fact; that since the Romanesque epoch the architects, however rude they were, applied principles very much opposed to those of the Romans, using various architectural members in their real function, dependant on the construction. From whence did they take those principles? Was this in their own feeling, by their sole faculty of reasoning? Was this in Byzantine traditions? That is what we shall notseek to decide. It suffices us for the fact to be recognized, and that is toward what will tend the examples that we shall give, so that no doubts in that respect can remain in the minds of our readers. First in examining the oldest edofices of the Romanesque epoch, we see that the architects have a pronounced tendency to erect them with a single order from base to top; scarcely do they mark the stories by a slight offset or band. This tendency is so marked, that they sometimes elongate indefinitely engaged columns, without takink into account the proportions of the Roman orders, and always make them support the upper cornice,(the true cornice), however high this may be above the ground. Omitting the architrave and frieze of the Roman entablature, the column directy bears the cornice, the useful and projecting member, intended to protect the walls against rainwater. That deranges the arrangement and proportions of the Roman orders; but as compensation it satisfies the reason. The Romans open arches between the columns of an engaged order, i.e., they place a first platband (architrave), and a second platband (frieze), and the c cornice above an arch, that we do not prevent anyone from finding very beautiful, but which is absolutely contrary to good sense. Romanesque architects, perhaps in imitation of Byzantine architects, adopted arches for all openings or for relieving the walls; they frequently set on the exterior engaged c columns, but no longer committed the fault of surmounting them by a complete entablature, only necessary when the columns are detached. The engaged column plays the part of a buttress (t this is its true part), and its capital supports the projecting slab of the crown of the edifice, otherwise termed the c cornice.

Note 1.p.318. See Discoursee on Architecture. (Entretions).

Here (1) is an example among a thousand of this so natural a principle of construction.[1] The cornice is here no longer a simple slab receiving the tiles of the covering; between the engaged columns this slab rests on corbels. The water falls directly on the ground without a gutter, and to find at the top of the wall sufficient thickness to receive the base of t the roof, yet without giving to the wall a thickness useless at the base, discharging arches borne on pilasters or engaged piers A B and on corbels increase the thickness of this wall below the cornice. Each piece of the slab has its joint over each corbel, which is indicated by reason. If the Roman cornice is decorated by modillions (that represent corbels, ends of beams) as in the Corinthian and Coposite orders, these are cut in the block of marbel or of stone composing the cornice. That is a considerable work of removing stone; there is a complete want of accord between the apparent form and the construction. On the contrary in Romanesque cornices the ornamental appearance is only the actual result of that construction. Each corbel is a block of stone deeply sunk into the masonry, b between the corbels is no more than a square stone slab, set just as are the metopes of the Greek Doric order. Then from one corbel to another rests a block of the slab. At certain distances the great engaged columns strengthen the construction by arresting all effects of overhang or derangement, that might finally be produced in a too great length of those slabs set only on the corbels. Such a cornice is easily repaired, s since it is composed of members independent of each other, t that can be removed and replaced without the need of scaffolds.

Note 1.p.320. From the apse of the church of Leognan, end of 11 th century.

The most beautiful examples of cornices composed of a simple slab resting on the capitals of engaged columns and corbels is found in Auvergne in the 11 th century. The cornice of the apsidal chapels of the church of Notre Dame du Port at Clermont is one of the richest; for not only the corbels and capitals are finely wrought, but the slab is ornamented by billets, and its middle surfaces between the corbels being decorated by a sort of sunken rosette. The spaces between the corbels a are composed of black and white stones forming mosaics, and b

beneath the corbels extends a band of billets that clearly r separate the different members forming the cornice from the surface of the wall. We give (2) the perspective appearance of this cornice, at A is the profile, and at B is one of the rosettes, sunk in the bottom of the slab.

This system of cornices is generally adopted in the provinces of the Centre, in all Aquitaine and Languedoc, during the first half of the 12 th centuries. In Burgundy the Romanesque epoch furnishes us with a great variety of cornices. Further, it must be stated, that cornices take the more importance and present projections the more pronounced, as they belong to p provinces rich in hard materials. In Ile-de-France, Normandy and Poitou, men rarely employed before the 12 th century any but the soft limestones so easily quarried in the basins of the Seine, Oise, Eure, Aisne and Loire. These materials did not permit making the slabs thin and projecting. The architects mistrusted them, not without reason, and they had adopted the custom of erecting their buildings of small materials, i.e, all having about the same dimensions. From the quarries we were brought supplies of stones ready squared,[1] from 8 to 12 ins. in height with equal width and lengths of 18 to 24 ins. They arranged that all the architectural members could accord with these dimensions. One understands then that they could not give a strong projection to their cornices. The Romanesque monuments so common on the banks of the Oise present neither cornices nor projecting bands, and the entire effect produced by these architectural members is due to a very refined and judicious study if the relations between the plain and moulded parts of the structure. Burgundy on the contrary, supplied hard and thin stones, easily quarried in large pieces; thus in that province the cornices have energetic profiles and present varieties in composition not found elsewhere in France.

Note 1.p.323. This method is still followed in Poitou, Saintonge, Angoumois, and on the banks of the lower Loire, as well as in the department of Aisne.

On the side aisles of the nave of the abbey church of Vezelay (last years of the 11 th century) is seen a cornice constructed always according to the Romanesque principle, i.e., co composed of corbels supporting a projecting slab; but its character nowise recalls the cornices of the provinces of the Centre.

As for style,it is very superior to them. We give it here (3) in all its details, seen in perspective and in section. The c corbel is frankly emphasized, and it has all the characteristics of the end of a wooden beam; but its mouldings return before the slab so as to form an enclosure around the double rosettes, that are between these corbels tike inclined metopes, as wooden panels held by means of tongues. The construction is perfectly in accord with the visible form; the corbels are l long stones penetrating the masonry, the slab is wide and between the corbels are only square slabs of stone 8 to 10 ins. thick. There is truly the edge of the roof of carpentry resting on a masonry wall, and it is impossible not to find there the tradition of the wooden structure. But let us not forget that when the nave of Vezalay was built, there was scarcely a century since all great edifices were covered and ceiled with wood, and that vaults were an innovation. (Art. Construction).

Besides, this cornice is a unique example; for in the same edifice the walls of the high nave are crowned in a different manner. In brief, an interval must separate the construction of the top of the nave from that of the side aisles, the architects had time to reject already the traditions of carpentry to decorate the edges of the roofs, they invented a new cornice, very singular indeed, but that already emphasizes stone construction. It is so composed of equal blocks of stone forming a series of quadrant corbels ornamented by ears like crockets (Fig. 4). At A the section of this cornice is made between two corbels; at B is its front; at C its horizontal projection, and at D its perspective. There is the origin of t the cornice frankly Burgundian, that only ceased to be used during the 13 th century. a cornice whose corbels are set without intervals between them, and whose most general form is that given by Fig. 5.[1] The drawing of this cornice in horizontal projection gives a series of semicircles cut out between the corbels• these are then hollowed in quadrant form. In section these corbels are drawn as a convex quadrant as in Fig. 4, with oor without crockets, which are the oldest; or as a concave quadrant with bevels like example 5, which are the mo most modern. Romanesque Burgundian cornices indicate advanced art of drawing, like all architectural members of that province, and particularly a very refined observation of the effects

produced by lights and shadows. Then the cornices, although altogether simple, have the appearance of strength and richness at the same time that satisfies the eyes; they crown the walls in a monumental fashion, producing a very piquant play of lights and shadows, that contrasts with the nudity of the surfaces. Before the 13 th century, one must go into the provinces of the Centre and of Burgundy to seek cornices of grand character and well combined. On the contrary in the North during the Romanesque period, the cornices are poor, project little (which is due to the quality of the materials, as we have previously stated), and little varied in composition. S Still the cornice with corbels is found everywhere before the 13 th century, it is an adopted system and exceptions are rare. The Romanesque architects of the North even push the application of the cornice with corbels to its most absolute consequences. Thus the corbels being made to preven the tipping of the slabs (they have no other reason for existence), and the pieces of stone forming those slabs not being all of the same lengths, and the corbels must naturally fall under the joints, it results that the corbels are spaced irregularly; their places are determined by the length of each piece of slab. It even frequently occurs that the moulding ornamenting the lower edge of the slab stops beside each corbel, and allows the vertical joint to be seen. That is further perfectly reasoned. The walls of the apsidal chapels of the church of Notre Dame-du-Pre at Mans are still crowned by lornices of the 11 th century, that are cut according to these principles.(6). The walls are built of small rough rubble, and the slab of the cornice is composed of pieces, some long and the others short. The corbels being set beneath the joints of that slab, are s spaced irregularly. In our Fig. it is seen that the moulding of the slab exists only between the corbels and leaves the joint free. Here again are found the corbels with shavings recalling those of Auvergne (Art. Corbeau), which causes the supposition, that this species of ornamentation had a great success during the 11 th and 12 th centuries. In the example given by us (Fig. 6), it still seems that the sculpturs have imitated that ornament without understanding its meaning, and have executed it in the most barbarous fashion; whice the schools of the Centre after the 11 th century are remarkable for

the refinement and burity of their sculpture.

Note 1. p.326. From the chapels of Notre Dome of Dijon, of beginning of 13 th century.

On the banks of the Oise and Aine, from the 11 th century, there is seen to appear between the corbels and moulded slab of the Centre and of Burgundy, a course cut in form of a little arch or of sawteeth. There exists around the little octagonal chapel at Laon, that passes for a chapel of Templars, a very singular cornice from the beginning of the 12 th century, conceived after these ideas. At the angles (7) it rests on engaged columns ending in heads; at the sides are beveled corbels receiving the intervals between the triangles forming the ornamentation. The joints of this sort of frieze are found o over the corbels, and a slab with a continuous moulding crowns the whole. On the corbels the spaces between the triangles a are sunk in little arches with inclined tympanums, as shown b by the section A made at the middle of a corbel.

The tradition of construction in wood still apears here. T The corbels are cut as one would cut the end of a beam, then beneath the triangles one finds again the shaving produced b by the carpenter in cutting a plank in form of sawteeth. However these last vestiges of wooden construction soon disappear in that province, so abounding in limestone materials suitable for construction, and the cornices with little simple or subdivided arches alone prevail until the end of the 12 th c century; now these cornices no longer have anything that recalls construction in wood.

Here (8) is one of those cornices so common in Beauvoisois; it comes from the little church of Francastel (beginning of the 13 th century). In the same province about the beginning of the 13 th century the architects reject the little arches, but they still retain the corbels, and they commence to ornament the slab of the cornice by sculpture, we find an example of this on the nave of the church of S. Jean-au-Bois near C Compeigne. (9).

If the banks of the Oise, Aisne and Seine between Montereau and Mantes, retain corbels beneath the slabs of cornices until the beginning of the 13 th century, i.e., until the frank application of the Gothic style, Champagne and Burgundy abandoned with still more difficulty that Romanesque tradition. Thus at

the top of the cathedral of Langres, 12 th century, we see a cornice in which the corbels assume a greater importance (10). The slab is alternately supported by moulded corbels and those representing the heads of men or animals. At the top of t the porch of Vezelay, from about 1130, are already noted these alternations of moulded corbels and of heads. At the end of the 12 th century, around the choir of Notre Dace of Chalons-sur-Marne, the cornice again presents corbels with heads, others ornamented by rosettes, and yet others somply moulded. The slab already assumes more importance, and it is covered by a rich decoration of leaves. (11).

In Angoumois, Poitou and Saintonge, the cornice with corbels in the style of that of Auvergne, is reproduced until about the end of the 12 th century. (Art. Chapelle, Fig. 33, which represents a part of the apse of the church of S. Eutrope of Saintes.

In Normandy the Romanesque cornice is very simple and only presents a small projection from the face of the wall. Frequently it is composed only of a simple slab 4 to 6 ins. thick. Yet these corbels with or without arches are frequently found. These corbels sometimes rest on a decorated fillet, as around the apse of the abbey aux Dames of Caen. (12; 12 th century).

From all the preceding examples, one can conclude thus; that during the Romanesque period and in the different provinces composing the France of today, with very few exceptions, the cornice consists of a row of corbels supporting a projecting slab. We shall see how the lay architects of the end of the 12 th century adopted an entirely new system of cornices, yet borrowing from the Romanesque cornice something of its appearance, viz:- the alternation of lights and shadows produced by the projections of corbels more or less distant. First let us state that at the moment of transition, the architects neglected Romanesque traditions, and even sought to free themselves from these entirely. Thus around the cathedral of Noyon, whose construction dates back to about 1150, the cornices are no longer simple mouldings. The church of S. Martin of Laon, built at nearly the same epoch, shows us at the top of the choir a cornice only composed of two superposed tablets.(13). On the nave of the same church is found as the entire cornice a slab ornamented by rosettes.(14). At the cathedral of Senlis alrea-

already appeared about 1150 cornices with crockets; now these crockets are nothing but plant stems terminated by a sort of bud or bunch of leaves not yet expanded (Art. Crochet), and they fulfil the function of corbels very close together; only they no longer support the slab, that has become thicker anf is independent.

If the architecture inaugurated by the lay school at the eod of the 12 th century essestially differs from Romanesque architecture, in the principle of construction, it perhaps varies still more by the infinite details, that enter into the composition of an edifice. Without analyzing them, Romanesque architecture followed the very confused traditions of Roman antiquity, Byzantine influences and local customs. For example, a cornice for Romanesque architecture is a projecting slab intended to remove from the walls the ends of the covering tiles, so that the rainwater may not wash the surfaces. The slab is simple or decorated; it is not always only one low course of stone, whose profile is given by caprice, but fulfile no useful purpose. If no tiles covered this profile the rainwater c can run down the suffaces, for its section was not made as to drip, like the facia of the Greek cornice. The architects of the epoch of transition left aside the Romanesque cornice with corbels; they also had no leisure to occupy themselves with those details; they thought of only one thing at first, which was to break with former traditions. But when they had solved the most difficult problems imposed by their new methods of construction (Art. Construction), they thought of applying to the details of architecture the rational principles that directed them. They desired no longer those roofs pouring the w water directly on the ground as on lower structures, they thought with reason, that a cornice must support a gutter, so as to direct the water in certain channels arranged to receive it; that it was useful to make access to the coverings easy, to allow roofers to repair them at all times. Hence these Romanesque cornices projecting so little and so weak could not suffice for them, no more than the thin slabs placed on their w walls, when they rejected cornices with corbels. Then they applied themselves to seek a form suitable for the purpose, that borrowed nothing from the traditions of the past. That form was found and quickly adopted; for thus one scarcely perceives

a transition, and indeed without its being possible to contest it, this new form abruptly appeared in Ile-de-France and Champagne, i.e., in the midst of that great school of lay architects, which at the end of the 12 th century established on new principles an architecture, whose forms were in accord w with those principles, and consequently new.

One of the oldest existing Gothic cornices is that crowning the apsidal chapels of the cathedral of Rheims. It is composed of a course enriched by leaf crockets, and a second course whose section is a drip moulding. (15). But here still the l lower course has a great importance compared with the upper course, the drip coulding recalls still the slab of the Romanesque cornice, and on its wash A at certain distances are left small horizontal surfaces, that Villard de Honnecourt terms blocks, that first allow the workmen to walk along the projection of these drip mouldings, and thus serve to divide the wa- water falling from the roof or running down the surfaces, and to divert it from the joints, for it must be noted that these cornices do not bear gutters aud gargoyles, but still allow rainwater to run off between these stone blocks. Indeed according to the project of Robert of Coucy, these chapels were to be surmounted by pyramidal roofs resting directly on the edge of the cornice.[1]

Note 1.p. 334. See Album de Villard de Honnecourt, annotated by M. H. Darcel. 1858.

Soon finding these drip couldings insufficient, the architects of the 13 th century gave them a greater projection; a g great height of the course. The upper cornice of the choir of the cathedral of Paris (16), rebuilt at the beginning of the 13 th century already shows us deep and strongly projecting mouldings A receiving a gutter leading the water to the gargoyles spaced at certain distances. A little after the setting of these cornices A, the architects of the cathedral added a second course B to the former drip moulding to give it a more vigorous appearance, and to avoid the thin place C, that might cause the fear of rupture. Already these drip mouldings A had been intended to support a balustrade, that was replaced when the second course B was set.[1] It will be observed that each c crocket ornamenting the first course D is carved in one block of stone, as if it fulfilled the function of a corbel. The c

cornices of the cathedral of Paris may be regarded as the most beautiful among those of the beginning of the 13 th century; those of the facade present the unique peculiarity, that their drips are made in two courses, so as to give them a greater projection. Thus the cornice that crowns the gallery which surrounds the towers and connects them is composed of three courses; one course of crockets anf leaves and two courses of the drip moulding (17); the upper course is pierced with holes at certain distances beneath the balustrade, to allow the water to run off and fall on the terraces.(Art. Cheneau, Fig. 2). The drip moulding here fulfils the purpose of a strongly projecting gutter, intended to remove the water from the surfaces.

Note 1.p.335. At the cathedral of Chartres are seen two drip mouldings superposed at the top of the chapels of the choir; it is evident that the architects of the beginning of the 13 th century perceived by their experience,that in setting a t thin slab on the first course of the cornice, but projecting far more than the Romanesque slabs, ruptures were produced. They first doubled these slabs, and then came to make them t thicker.

Generally the drip mouldings are made in height of a single course; but the details of the western facade of the cathedral of Paris are of dimensions above the ordinary, and it seems that the architect to whom is due the upper part of that facade, i.e., the two towers with their open gallery (about 1225), desired to give the architectural members a relatively very great importance. The upper cornice of the two towers, intended to receive the bases of stone spires, whose construction was only begun, is unique in the height of courses in the old Gothic style. It is composed of two courses of crockets, each having a height of 2.5 ft. between beds; one of the drip surmounted by two courses with wash, and the balustrade set when the continuation of the spires was dropped. Each crocket is cut in an enormous block of stone, as shown by our Fig. 18; the courses of the drip and the wash above are cramped all a around by double cramps A taking the place of the fourfold an anchoring. One sees that the architect had taken precautions to be able to erect his spires without danger.

Still the drip mouldings of cornices of the beginning of the

13 th century probably appeared to have profiles too angular and rigid for architects already very advanced at the middle of that century, for at that epoch about 1240, we often see the drips on the last course of the cornice replaced by a less severe profile. A round with a projecting edge serves as a d drip and replaces the drip moulding of the primitive Gothic corona. The cornice that crowns the tower of the cathedral of Troyes is one of the most beautiful, that we know of that brilliant epoch of Gothic art (1240), and it is covered by a ro- round corona, profiled as we have just stated.

Fig. 19 gives the front and section of that cornice. It will be noted that the joints A are skilfully arranged to combine wi h the double row of crockets, and to not cut across the s sculpture, as so many of our architects fail to do today. Here the ornament is apparently continuous, but ranges perfectly the place for the vertical joint. About the same epoch, in the provinces into which the Gothic style and all its consequences penetrated with difficulty, as for example in Normandy, we see the Romanesque traditions persist beside the new forms. The cornice of the nave of the cathedral of Rouen, in that r respect, is very singular to observe. One finds there the little Romanesque arcade combined with the crockets of the 13 th century surmounted by the rounded corona (20). It presents to us very judicious jointing, like all architectural members of that epoch.

The cornices offer few varieties during the course of the 13 th century; almost always they are composed of two courses; one in the form of a hollow decorated by crockets or leaves, the second bearing a projecting drip moulding. But the corona with a wash only exists if the cornice forms a gutter, for if (as frequently occurs in civil and military architecture) the roof gutter rests directly on the edge of the cornice, that i is terminated by a vertical fillet and not by a wash. Thus t the slates or tiles form a drip before that fillet, and the upper course of the cornice is itself profiled as a drip, to avoid all chance of injury on the surfaces, in case the roof gutter fails.

We give (21) one of those cornices so common during the 13 th and 14 th centuries in civil architecture, a cornice whose upper course at need serves as a drip, and whose lower course

is without sculpture and forms a great projecting round. There still exist on the palace of justice of Paris several cornices of that sort, that have a strong effect, though simple.

Now here is a pretty cornice composed of a single course f forming a drip; it is placed at the top of the tower called of Justice at Carcassonne (21 bis); end of 13 th century). The moulding is stopped at each joint strengthened by a projection forming a corbel. That is well reasoned, particularly when all the stones must be cut on the yard before setting, for t then it is certain that the joints will show no offsets, and that the mouldings will not be cut crooked. The profiles of these cornices without wash are always cut so that the lower edge of the fillet forms a drip to drop water beyond the surfaces, if the first row of tiles does not perform that function. (22).

The 14 th century generally retained cornices in two courses, and the only difference found between these cornices and those of the 13 th century is, that the sections of the drips are leaner, and the ornaments, leaves or crockets, are more slender and dryer in execution. Yet it is un- necessary to believe, that the architects of that epoch may not have sometimes sought new combinations. Thus we see around the choir of a church S. Nazaire of Carcassonne (about 1325) a cornice, whose composition is as original as its execution is beautiful. That cornice returns to Romanesque traditions, i.e., it is composed of a row of corbels supporting a course forming a corona, but decorated by broad leaveu between these corbels; it receives a gutter and a balustrade. Here (23) is the perspective detail of that cornice. At A is drawn its section between the corbels. Placed at a great height, this cornice produces much effect, because of the play of shadows and lights on these pr projections so frankly accented.

Here, contrary to the customs of the artists of the 14 th century, the details of the sculpture are at the details of the monument; they do not dwarf the massas, but on the contrary emphasize them by rich and broad execution.

During the course of the 14 th century, we see the crockets gradually replaced in the lower course of cornices by bands of deeply cut leaves, but whose irregularity and lean execution no longer gives projecting points ejually spaced, those

those heads of crockets that at a distance have such a monumental effect, and still recall the corbels of the Romanesque e epoch. We present (24) one of these cornices of the end of the 14 th century coming from the top of the north tower of the c cathedral of Amiens. The cornices of the 14 th century, independently of the meager profiles and the dryness of the sculpture, generally have small projections, which then become necessary when all horizontal members were sacrificed to the vertical lines; but about the middle of the 15 th century, on t the contrary the crowning cornices have an increased projection, often being composed of a considerable number of courses corbelled out, decorated by bands of leaves, so as to present easy passage at the base of the roofs. The leaves extend before deep hollows, separated from each other by fine mouldings, and the coronas recall the exaggerated form of the round drip moulding of the end of the 13 th century, i.e., the upper wash is concave, the round is flattende and terminates in a strongly projecting drip, the lower hollow being deeply sunk.(25).

At the beginning of the Renaissance is already perceived, particularly in civil architecture, a return to the forms of the Roman cornice; the Gothic drip moulding is omitted. Still it was only till about the middle of the 16 th century, that the Roman entablature reappeared in edifices. The beautiful c cornice of the square tower of the chateau of Blois, built u under Louis XII, still retains its Gothic members, with some details borrowed from the antique architecture. Above the row of recurved ovals is placed an arcade supported by corbels, t that recalls the crowning machicolations of the strong castles of the 14 th century. On the arcade is found the course with a hollow decorated by leaves arranged like the crockets of the 13 th and 14 th centuries, then the drip of the 15 th centuhy is scarcely changed.[1]

Note 1.p.343. See examples de decoration by L. Boucherel.

The city hall of Orleans, built in 1442 by master Viart and in spite of the date, which presents all the characteristics of that epoch of Louis XII, is crowned by a cornice of that kind,and that of the square hip roof of the chateau of Blois.[1] At the chateau of Chambord are still found the last traces of the cornice of the castle of the middle ages, with its arches in little niches representing machicolations

Note 1.p.344. See Arch. civo et dom. by MM. Verdier and Cattois.

We shall terminate this Article by giving some cornices of wood taken from civil structures. That first (26) is commonly found arranged at the base of the roofs of the houses of Troyes built of half timber work. This is one principle for a cornice adopted during the 14 th and 15 th centuries. Blocks form the corbels on the exterior above the plate, and carry a small plancher of boards under the furring. The other cornice (27) dates from the beginning of the 15 th century, and belongs to a modern house situated on Rue de la Savonnerie at Rouen. On a moulded plate A are set the little posts B that receive the joists C of the upper floor; the ends of these joists are relieved by the corbels D. Between these corbels are set little arches cut in a board, which forms a series of machicolations. On the ends of the joists rests the plate E of the cornice; the spaces G between the corbels are filled with planking.

CORPORATION. Guild. Trade Union of Masters.

An association or oath-bound guild (according to the ancient signification of the word "conjuratio") of artizans, united by particular agreements consisting of rights and receprocal duties. There existed associations of trades under the Roman empire; they even claimed to have been established after Numa, and they were designated by the name of college or body of artizans. In the middle ages the mechanics, merchants and workmen of the cities retained the Roman traditions in the g great southern cities, and the guilds did not cease to exist, while in the cities of the North they were scarcely seen to establish themselves till the moment of the enfranchisement of the communes, i.e., about the 12 th century. The kings took them under their protection, as one of the means for weakening the feudal power. Under S. Louis they were regulated at Paris by Etienne Boileau.[1] To become a member of a guild at that epoch, it was necessary to pass an apprenticeship that lasted more or less time, at the end of which one became a master. The masters exercised a sort of control over each other, consequently maintaining the price of work and the good quality of the products. Free competition did not occur then, and the merchants or artizans of the cities could only resist the tyranny of the lords by closely combining under the patr-

atronage of the sovereign. Thus they formed a powerful body hich it was necessary to consider, and that by its organiza- ion itself assured to the sovereign certain resources regul- rly received. Membership was frequently obtained by money, hich formed a resource for the treasury¹ or indeed also the ing for a capital sum once paid, authorized the guild, which hus acquired the right of collecting certain dues on the im- ort of merchandize, tolls on rivers and bridges, at the ent- ance of ports, etc.

Note 1.p.246. See Reglements sur les arts et metiers de Pa- is rediges au XIII siecle. Livre des metiers, by Etienne Boil- ou. (Coll. d. doc. ined. sur l'hist. de France).

To not wander from our subject, the body of the trades con- ected with buildings consisted in the 13 th century of carp- nters, masons, stonecutters, plasterers and quarrymen, stat- aries, painters and sculpturs, bridge-builders. As for the asters of works, which we term architects today, they do not ppear to have ever formed a guild; we cannot have even a very ague idea of their powers before the 15 th century. We see t hat they were called to the cities to build edifices, and t hat to them were paid the commission fixed during the durat- on of the work (Art. Architecte); but did they have charge f the contracts made with the different chiefs of the work- en? Did they prepare specifications and estimates? Or regu- ate the accounts? All that seems doubtful. From the end of he 13 th century, cities, abbots or chapters are seen to make contracts with the masters of the various trades without the ntervention of the architect. He appears to retain an indepen- ent position and to incur no responsibility; in brief, he is n artist, who causes the execution of his works by workmen aving no relation to him other than those of furnishers or jobbers to a general superintendent. The system of fixed pric- es was not generally employed, the workmen in each trade wor- ked by the piece, the architect distributed the pieces, and probably a checker kept account of the work of each one. On the great inscription cut at the base of the south portal of the cathedral of Paris, the architect Jean of Chelles is des- ignated by the title of stonecutter. Robert of Luzarches and his successors, Thomas and Regnault of Cormont, take the tit- le of masters in the inscription of the labyrinth of the cath-

cathedral of Amiens. It is certain that a mason or stonecutter could not conceive and cause to be executed the different parts of an edifice, in the erection of which the carpenter, s smith, sculptur, joiner and glass painter must participate. And in Gothic architecture the various members of the construction and decoration are too intimately connected, that one can admit for an instant, that each trade can act independently without a supreme chief. One of the most remarkable qualities of that architecture is, that all is foreseen, all comes to set itself in the necessary and prepared place. Thus a head is necessary to foresee and to give orders at the proper time. However that may be, if the guilds connected with building labored much during the middle ages, if they left remarkable t traces of their skill, from the political point of view they did not take the importance of many other associations. One rarely sees them take part in the troubles of the communes, demand an extension of privileges, impose conditions, or form those powerful coalitions, that so long disquited royalty.

COUPE DE PIERRES. Stonecutting.
See Arts. Appereil, construction, Trait.

COUPOLE. Dome.
A hemispherical vault, one generated by two curves intersecting at the crown, or by a half ellipse placed on a circular or polygonal plan, supported by four transverse arches or silid walls. The word dome was only employed after the invasion of Italian architecture in the 16 th and 17 th centuries; it is the Italian word "cupola" frenchified. The Romans from the time of the republic had built domes on circular walls, or t those forming a great number of sides. But it was at Byzantium, that were erected by the emperors the first domes placed on pendentives. It is scarcely credible that the celebrated dome of S. Sophia was the first construction of that kind attempted. The attempt would have been very bold, since that d dome has a diameter greater than all other vaults on pendentives that exist. Did the idea of constructing a dome on pendentives come naturally to the Byzantine architects after a s series of experiments, or was it suggested to them by the study of oriental monuments unknown today? That is what we shall

not undertake to decide. it is certain (and to thiis we must restrict ourselves in this Article), that the Byzantine dome, for the architects of the first centuries of the middle ages, was a type that they sought to imitate in the West. Under Gharlemagne was erected that of Aix-la-Chapelle in imitation of the dome of S. Vitale of Ravenna; but in these two examples the pendentives do not appear, and the domes start from the base. At Venice at the end of the 10 th century were built on pendentives the domes of S. Mark, of that edifice was copied a little later at Perigueux. (Art. Architecture Religieuse, Figs. 4, 5). Yet before that time experiments with vaults on pendentives had been tried in the West. There exists at the eastern point of the island of S. Honorat on the shore of the Mediterranean a little church, whose construction appears to date back to the 7 th or 8 th centuries; it is the chapel of S. Ferreol, here is its plan (1) and the external elevation of the entrance end (2). It is difficult to imagine a more barbarous structure. On examining the plan, one sees at A the n horizontal projection of a small dome with circular base; now the spaces B do not form a tunnel vault, as might be thought, but warped pendentives, so as to form a horizontal section f for the dome A. The constructor simply warped the courses of a tunnel vault to arrive at that vault, which has produced a very singular jointing.

The internal view of the chapel (3) shows the arrangement of the courses of rubble that form the pendentives of the little almost conical dome surmounting them. If we make a section on the line C D of the plan (4), we see indeed that the dome is not a hemispherical or elliptical calotte, but a curved-conical one. We do not believe that there exists in the West a d dome older than that of the church of S. Ferreol. And this ex- example, which probably was not the only one, will indicate that the architects of the first time of Romanesque art were very much occupied with the idea of erecting domes on pendentives; for certainly there were twenty simpler procedures for vaulting the principal bay of this chapel, without the need of resorting to this means. There was evidently the idea of imitating those Byzantine structures, which then passed for masterpieces of the art of architecture.[1]

Note 1.p.350. M. Merimee took care to draw this little mon-

monument, and has had the courtery to furnish to us the precious sketches, that he made during his stay at S. Honorat.

The domes of the abbey church of S. Front at Perigueux can be regarded however as the first, whose construction has exerted a considerable influence on western architecture. Those domes, five in number, equal in diameter and height, and with circular bases, are placed on pendentives; but these pendentives are not jointed as proper; the beds of the courses are horizontal instiad of being normal to their generating curves-these are actual corbellings that are supported only by the adhesion of the mortar and by their spherical form. Thus it is evident that the architect of S. Front imitated the form of the foreign structure without taking in account its principle, and this fact alone tends to oppose the opinion expressed by our learned friend, M. de Verneilh, viz:- that the actual church of S. Front was erected by an artist brought from the s shores of the Adriatic.[2] We have seen already in the preceding example, that the builder of the little church of S. Ferreol, desiring to build pendentives, has found no means to give them nearly the proper curvature, other than to incline the courses of rubble on the haunches of the transverse arches, i.e., to superpose courses of voussoirs, well or badly, by projecting them beyond each other, connecting them in the rudest manner at the point of junction. In construction and in everything requiring both calculation and experience, it must never be assumed that the simplest means were first adopted; the contrary occurred. The principle of construction of pendentives being once known seems very natural; but it must appear to t the eyes of rude artists as a real feat. It was never understood by Romanesque architects, and if we possess in France some domes on pendentives before the Gothic era, those have onl n an appearance, not a system of construction understood and o practised. Besides, the domes resting on the walls or on pendentives that exist in the East, and those of S. Mark of Venice, are either built of brick, of small tufa rubble, or of c concrete composed of light stones and mortar; properly speaking, there is no jointing. These vaults are generally a casting on a form or a concretion of irregular materials made to adhere together by the mortar. Still today in the East, masons in closing a dome do not build a carpentry centering; they c

centering, they content themselves with a strip of wood fastened at the centre of the dome, which they move in all directions, building the masonry according to the radius given by this strip like a small plaster dome. In the West in spite of Roman traditions, construction in cut stone has replaced the construction in concrete and brick. It was then necessary to joint the pendentives. Where could be found pendentives jointed in stone? The domes of S. Mark of Venice are of brick, and under the mosaic the pendentives consist of discharging arches also in brick, turned over each other by means of centering, or which is more probable, to a rod, one end fixed at the centre of the generating sphere of those pendentives as shown by Fig. 5. We do not know if the pendentives of the dome of S. Sophia of Constantinople are thus constructed; it is probable, for that corresponds to Roman traditions. If that be so, pendentives jointed in stone, i.e., whose beds are normal to the generating spherical curve are a very modern invention, that does not date earlier than the 16 th century, and the pendentives of the first centuries of the middle ages are only corbellings or arches superposed in a spheroid. These technical observations have more importance than often believed, for t they aid in explaining the transformations and influences, of which one cannot render an exact account, if they are neglected.

Note 2.p.350. It must be stated, that when M. de Verneilh published his book on Byzantine architecture in France, M. Abadie, the architect charged with the restoration of S. Front, had not commenced the work that he directed with so much devotion and intelligence, and this fact of the singular construction of the pendentives had not been mentioned.

It is very strange that the western Romans did not invent the dome on pendentives, or if they did invent it, that no t trace of it remains to us; for they had caused the penetration of cylindrical tunnel vaults into spheres, and pendentives are nothing but curvilinear triangles of the sphere left between those penetrations. Yet the dome of S. Sophia, those of S. Mark of Venice and those of S. Front of Perigueux, are not only spheroids penetrated by cylinders. There is first a primary spheroid on the four piers, that is penetrated; then above these intersections is a second portion of a sphere with elevated centre. This clearly distinguishes the Byzantine from

the Roman dome. To make our definition understood by a Fig.(6); let A be the horizontal projection of a dome placed on four piers and four transverse arches. The section on the axis C D of this dome will give in vertical projection the profile E, but the section on the diagonal G H will give the revolved section I. On this principle were traced the domes of S. Front of Perigueux. The four transverse arches being composed of broken curves, the constructors were let to trace the spheroid penetrated by these arches by two lines drawn with the compasses, G K and H K. The horizontal section of this primary spheroid was made at L, and a projecting band was set at this level to support the false centres intended for constructing the dome. This dome itself is not a hemisphere, but is obtained by means of two curves. Regularly, these pendentives should be jointed in section according to the diagonal, conformably to the trace M, i.e., to present rows of voussoirs with beds normal to the curve H K, with horizontal tails; the constructors of S. Front did not take that trouble, and were contented to set the courses of those pendentives by corbelling according to the trace N. Due to the curvature of the pendentives, these corbelled courses of stone did not tip; but they m might crush the point of the triangle and detach themselves in one piece from the transverse arches, which occurred. As for the dome proper, it is composed of a sort of drum O, consisting of horizontal courses and a calotte surmounted by slabs with a load at the apex. At S. Front the transverse arches are thin and their faces are vertical, the pendentives only commencing their curvature on the extrados of these arches. But s soon the constructors thought and not without reason, that t these transverse arches supporting an enormous load, it was necessary to give their voussoirs long tails; but to not raise the pendentives excessively, or to give them a strong inclination, they caused the voussoirs of these transverse arches t to enter into the first spheroid. Then being embarrassed to know how to arrange the two transverse arches on the projecting angle of the pier, they wished to separate both as soon as possible; for this purpose they lowered the centres of these transverse arches below the level of their imposts, and thus inclined their curves from the imposts. In the church of Souillac, whose construction is later than that of S. Front, the

architects have already adopted these modifications. At P we give the plan of an angle pier of that church, with the horizontal projection of the transverse arches and one pendentive; at R is the vertical projection of this angle, and at S a perspective view.

We no longer see domes with pendentives appear outside the western provinces during the Romanesque epoch, and in those provinces themselves at the end of the 11 th century and the beginning of the 12 th, trumpets or corbellings very often replace them. The pendentives were evidently an importation not perfectly understood by the constructors, and whose jointing always caused a certain mistrust in architects, when they had to erect great edifices. But on the banks of the Charente one finds a quantity of little churches with domes on pendentives, well conceived and well executed. It suffices to present here a single example (7), taken from the church of Montmireau, 12 th century. Here the transverse arches form a part of the pendentives, and the faces of their voussoirs are skew to conform to the curvature of the lower spheroid, as we have previously indicated in regard to the domes of Souillac. The church of the city of Montbron, situated east of Angouleme, and which is far from the province where the dome on pendentives was generally adopted, already shows us no longer a hemispherical calotte over the crossing, but a dome with eight sides supported on four trumpets surmounted by projecting corbels.(8). This m method was generally followed during the 11 th and 12 th centuries in Limousin, Auvergne, and part of Lyonnais, and even in Nivernais.

The dome that crowns the centre of the crossing of the church of Notre-Dame-du-Port at Clermont (11 th century) is on neither a circular nor an octagonal plan, but it partakes of both forms. The constructor has experimented. He commenced by passing from the square to the octagon by a course A (9) set as a corbel; on that course he has placed a sort of trumpet, and then has turned a small arch B on corbels. All that does not form a regular polygon, but an octagon with four large and fo four small sides. On that base he has erected well or badly an irregular octagonal dome with rounded angles, as shown by the plan. This dome is perfectly abutted at the side next the nave by a tunnel vault, whose crown rises above the open arca-

arcade D, as indicated by the dotted line. But the tunnel vaults and the trumpets are much lower, and the constructor feared the thrust of the dome toward the transepts. To avert th that thrust he found nothing better than to establish two half tunnel vaults C, that spring from the arches E turned on the extension of the side walls of the side aisles, and beyond h e was able to erect his transept G. At first sight this construction is singular, complicated, particularly in referring it to the epoch when built (11 th century); one asks where the Auvergnats obtained the examples, which served them as models.

We are little disposed to accept absolute systems, when this concerns the history of the arts, and we believe that at all epochs, those that occupied themselves in works of understanding were subject to very diverse influences, contradicting e each other, and that what frequently appears to us to satisfy the conditions of unity of style and conception, because of the distance separating us from those times, is merely a mixture of incongruous elements. It is the same with works of ar art as with those animals in a menagerie, that one sees only at rare intervals and in small numbers; those of the same species all seem to resemble each other; but if one collects them and lives in the midst of them, he soon comes to distinguish individualities, to find a particular aspact in each one. If one brings a hundred negroes from Sennaar, you cannot distinguish them separately on the first day, but if you remain amo g them, you will soon find that between two negroes are as many differences as between two white men; you will find relations and resemblances of father and son. Well! The same phenomena are produced (if we may be allowed the comparison) when it c concerns monuments of art far removed from us by he taste th that erected them, or the space of time separating us from them.

Let us analyze this church of Notre-Dame-du-Port, one of the most interesting monuments of France, and we shall find very diverse origins, although this little monument may have for us today a character of apparent unity. The plan (Art. Architecture Religieuse, Fig. 9) is that of a Roman basilica with side aisles behind a sanctuary and four apsidal chapels; now in the 11 th century the architects scarcely had to guide t them only the Roman traditions of the arts of the East. The c church of S. Sophia of Constantinople was for these artists

a type, an incomparable work, the supreme effort of human intelligence. After the renaissance of the arts under Charlemagne, men on the good part of the European continent believed that they could do better, than to approximate the Byzantine types, or at least to be inspired by them. Well! If we examine the sections of the church of S. Sophia, we see that the great central dome is abutted lengthwise by two half domes or quarter spheres, and that in the other direction, i.e., that corresponding to the transepts of our churches, that dome is abutted by a series of flying buttresses that strengthen it, absolutely as the half tunnel vaults of the modest church of Notre-Dame-du-Port strengthen its little dome. Below the dome of S. Sopnia and under that of Notre-Dame-du-Port of Clermont, we see the lateral walls pierced by arches. At S. Sophia that arcade is an archotectural arrangement of great richness; at Notre-Dame-du-Port, these are three modest arches supported by two little columns. At bottom the principle is the same, a and it must be said in praise of the Auvergnat architect, that while inspired by the principle of construction of an immense edifice, he knew how to adapt himself to the scale of his modest church, and to not reproduce at a small scale forms suitable for a vast structure. The dome of the church of Notre-Dame-du-Port is not supported on pendentives, like that of S. Sophia, it is true; but we have just seen that the western architects, even in applying this system of construction, never undesstood its mechanism. The Auvergnat school of the 11 th century had its methods, and was very advanced in the way of the arts; it had scrupulously retained some remains of Roman traditions; it did nothing without perfect knowledge of the s subject (and the good preservation of the edifices erected by it proves this), and probably not understanding the system of construction of pendentives, it preferred to employ the practical means known to it, of which it was assured; which further did not prevent its architects from taking from the East what their intelligence permitted them to seize as readily. To summarize, we believe that one can see in the church of Notre-Dame-du-Port the plan of a Roman basilica, on its crowning tr transepts being erected a structure, that presents all the elements constituting the structure of S. Sophia. From which, one can conclude, that in these Romanesque churches of the

Centre of France Byzantine influence is at least as marked as in the church of S. Front, which on the whole is an imitation of S. Mark of Venice, that itself was a copy of a Byzantine edifice of which a trace is no longer found. We think that t the domes in the West have their origin in oriental architecture, that of the West as well as that of the Centre or that of the Rhine and of Germany, and that if one desires to find somewhere a local Romanesque architecture, it will be necessary to seek the provinces of the North, in Ile-de-France and Normandy. Certainly pendentives have a major importance, but do there only exist in the ancient empire of the East domes on pendentives? Greek churches, a quantity of small monuments of Georgia and Syria have domes without pendentives, borne on trumpets, arches, niches or drums, are these less Byzantine than the church of S. Sophia? And is it well reasoned to say? "What distinguishes the Byzantine dome from other domes are the pendentives; then all domes supported otherwise than on pendentives are foreign to Byzantine influence." It should be said, "foreign to the influence of S. Sophia or of S. Mark of Venice,", but not to Byzantine influence, again we have just presented, at least we believe so, that although the dome of the church of Notre-Dame-du-Port may not be on pendentives, yet it can be a daughter of S. Sophia. It has been already s stated; that when it concerns the recognition of the influences that act on the development of the arts, especially after Grecian antiquity and after the Romans and Byzantines, i.e. in regard to a considerable mass of traditions, it is prudent to analyze the productions of the middle ages with the greatest care, and to not hasten to adopt or reject some of these influences, for nearly all act, at least in the Romanesque era.

Since we are now on this chapter, domes furnish us with the proof of the force of those traditions accumulated in spite of those affected by them. Thus we have caused to be seen in several Articles of the Dictionary, and particularly in Art. Construction, how the architects of the primitive Romanesque epoch were compelled to place vaults on the plan of the Roman basilica, and how they attained this after many fruitless attempts. This problem solved (and solved by western architects, it must be said), the plans were modified in their general a arrangements, but the mode of vaulting the naves made rapid

progress until the Gothic epoch. The Roman tradition of the plan persisted. There arose the influence of the dome in the midst of the work of these constructors; did the western architects that desired to submit to that influence necessarily modify the Roman plan? Not at all! They retained it and perched the domes on the crossings of their basilicas. At Pisa in the 12 th century we see the constructors retain the Roman a arrangement of the basilica, and cover the naves by carpentry at the same time that they erect a dome over the transverse aisles. Yet this was to place a vaulted monument on a monument commenced to not be so, it was to superpose two edifices, as if one wished at the same time to retain the trace of all opposed influences that they obeyed. In our time M. Quatremere de Quincy says with reason in his Dictionnaire historique d' architecture:- [1]"We cannot help regarding the superposition of modern domes on the centre of the naves of a great church, and seen particularly fromthe exterior, as an actual superfluity and an architectural pleonasm. In fact if afar and seen from outside the city, these pyramidal masses produce agreeable effects, one is compelled to confess, that seen from near at hand, they produce no idea other than that of one edifice mounted on another, frequently with nothing connecting them, and above all that requires this. let us add that in the interior one can only see a duplication of motives, forms, of entirety of effect." Thus eight or nine centuries after two opposed traditions have exerted an influence on architecture, h here again is an author, who without considering these different origins notes their discordance, recognizes two principles present, two principles that nine centuries of effort have not been able to combine. Still let us say that the first attempts have not been the least good, and that fi the dome of the Pantheon of Paris presents with the rest of the edifice duplex motives," that we feely admit, if motives could be accused of dupilcity, one cannot say as much of the domes of our pretty Romanesque edifices of Angoumois and Perigord, that a are placed on structures arranged from the base to receive them, and which on the exterior as the interior, are properly joined to the lower parts.

Note 1.p.359. See Art. Coupole).

But let us proceed. While in the West of France we see the

dome on pendentives take root and develop, while in the provinces of the Centre men seek to place it on trumpets, corbelling or corbels; in Provence at the beginning of the 12 th century the dome also crowns religious edifices. In Auvergne on the plan o the Latin basilica is placed the dome; In Peovence this is on the Roman plan borrowed from the halls of the baths, composed of bays with internal buttresses, on plans that approach the edifice known at Rome under the name of basilica of constantine, that is planted the dome. The church of Notre-D Dame-des-Dons at Avignon, though mutilated today, presents us with an example of the invasion of the dome on plans nowise arranged to receive it. The single nave of Notre-Dame-des-Dons is composed of rectangular bays with tunnel vaults on p pointed transverse arches maintained by enormous buttresses, between which now open internal chapels. Here (10) is the plan of three of these bays, the church only comprising six of them. On the next to the last instead of a tunnel vault are eight round longitudinal arches, corbelled out on each other, resting on the two great transverse arches as indicated by t the dotted lines K L on our plan, so as to attain the perfect square A B C D. In the interior of the square four small pendentives form the octagon. On this base rises a small dome, whose hemispherical calotte rests on eight columns between w which open the windows. We give (11) the section of this construction on the transverse line E F, a section that will avoid long explanations. On the exterior this dome is a little octagonal edifice appearing to rest on the stone slabs forming the covering, and not connected in any manner with the rest of the church. At the church of the Major at Marseilles, is f found an arrangement similar to this.

We must then verify here again the Byzantine influence (for this dome of Notre-Dame-des-Dons perfectly recalls certain s small Greek domes) coming to mingle with Latin traditions. If we transfer ourselwes from the banks of the Rhone to the banks of the Rhine, we shall also find monuments of the 12 th century in which the dome appears, and this is always the Byzantine dome, although it may not be raised on pendentives. But at f first let us make an excussion to Athens. One of the largest churches of that city is the church of S. Nicodemus,[1] of which we give the plan (12), also conforming to most Greek plans.

A single dome surmounts the centre of the edifice. If we make a section on the line A B, here is the trace obtained (13); f four niches or rather four corbelled angles, pass from the construction of the square to the circular plan that receives the calotte by means of oblique tympanums or eight scarcely apparent pendentives, that surmount the arches. There the construction has not dared to attempt the four pendentives and has replaced them by merely four niches, that correspond to the trumpets so common in our Romanesque structures of the West. Well in the cathedral of Worms, we see a dome (the eastern) constructed according to this mode. The only difference between thes structure and that of church S. Nicodemus of Athens is, that at Worms the dome is octagonal instead of being hemispherical, but the artifice employed in the construction of the dome of S. Nicodemus to transfer from the octagonal to t the circular plan could not be admitted in the great church of Worms, where the dome rests on four transverse arches instead of beiug supported from the ground; further the construction of the eight oblique tympanums over the transverse arches and trumpets would have occasioned difficulties in jointing, with which the architects of the Rhine were not familiar. Examining this last construction with some care, do we not see that the triangle A B C beneath the diagonal arch is an actual pendentive by its form if not by its jointing? For the beds of the courses are horizontal.

Note 1.p.360. See Choix d'eglises Byz. en Grece, by A Couchord. 1842.

From all that precedes one may conclude; that io western Romanesque architecture, that beside the persistent Latin traditions are found almost everywhere a Byzantine influence evident by the introduction of the dome. But why reject such an influence in the mode of construction, when we see it manifested in such an imperative manner in sculpture and painting d during the 11 th and 12 th centuries?

Yet if the architects of Auvergne, of the West, South, and the banks of the Rhine adopted as well or badly, the eastern dome to edifices Latin in plan (S. Front excepted), those belonging to the schools of the North did not allow themselves to be led to that mode, at least in their constructions; for as for the ornamentation, statuary and painting, on the cont-

contrary, they sought to approach the oriental types. (Arts. Ornement, Sculpture, Statuaire). But in the arts as in all e else in the world, there are transitions, one submits frankly to a foreign influence, another resists it absolutely, a third endeavors to use that influence as a means of expressing the ideas belonging to it. Precisely at the limit separating edifices with domes from those without them, there is in France a unique monument, foreign, in which are found, so to speak, influences of oriental art with the methods of construction adopted in the North at the beginning of the 12 th century, this is the church of Loches.[1] This church with a single nave is divided in four bays with square plans, on the two end b bays rise towers (Art. Clocher, Fig. 27); but on the two intermediate bays, instead of domes or cross vaults are hollow pyramids borne on corbellings and covering the nave (15). O One can imagine the effect produced by an interior vaulted in such strange fashion. Those enormous hollow pyramids, dark at their summits, cause an indefinable feeling of terror. The great corbelled triangles that serve as their bases are only the prolongation of four sides of those pyramids between the transverse arches and the side arches. Here at least the construction is not in accord with the form; for hollow pyramids composed of courses with horizontal beds form one of the most stable structures, that it is possible to combine. For the d domes of the West the architect of the church of Loches has substituted the hollow pyramids of the towers of the 12 th ce century, thus he avoided thrusts, and he applied a mode of co construction, which was familiar to him, in the plans of those churches so common in Saintonge, Angoumois and Perigord.[1]

Note 1.p.3-4. If an edifice should merit all the care of t the administration, that is the church of Loches; this is a m monument unique in the world, complete, and with a rude beauty. It is to be regretted that it is almost abandoned, although its preservation is of the highest interest for the history of the art.

Note 1.p.367. If this curious edifice were found in Italy, England or Germany, it would be known, studied, praised, and probably preserved from all chance of destruction, an presenting one of the most extraordinary conceptions of Romanesque art. Unfortunately for it, it is in France at some miles from

the banks of the Loire, left to the restorations of the architects of the locality, who are far from suspecting its importance from the point of view of the history of art, and who cannot appreciate its strange beauty. For it must be stated, that the construction of this monument is executed with care, that the sculpture and mouldings are in the most beautiful s style.

The dome disappeared at the moment when Gothic art was formed; yet the provinces in which this mode of vaulting edifices had been generally applied could not entirely forsake its influence, and we see in Poitou and the provinces of the West, the Gothic cross vault again subject to this influence. (Art. Construction; see the examples presented in Figs. 61, 68).

COURONNEMENT DE LA VIERGE. Coronation of the Virgin.

The coronation of the Holy Virgin is one of the subjects f frequently represented by the sculptors and glass painters of the 13 th century in cathedral churches and even parish churches. At that epoch (13 th century) the adoration of the Virgin had assumed great importance compared to what it had previously been, the most cathedrals that the bishops erected t then in the North of France were placed under the name of the mother of God. Naturally the sculptors must relate her story in those edifices, and among the subjects preferred, her triumph, i.e., her coronation in heaven took the first place. There is seen a coronation of the Holy Virgin on the tympanum of the central portal of the cathedral of Laon, begun in the 13 th century. There Christ blesses his mother with his right hand, and holds the closed book of the gospels in the left h hand. At Notre Dame of Paris exists a magnificent coronation of the Virgin on the tympanum of the left portal of the western facade (about 1215). There is another above the lintel of the little red doorway of the same church on the north side. (about 1260). On the principal facade of the cathedral of Senlis is one of the oldest coronations of the Virgin (end of 12 th century) and one of the most beautiful in style. At the ca cathedral of Rheims on the gable of the central portal, the same subject is represented in colossal dimensions. At the p portal of Calende of the cathedral of Rouen (14 th century) is to be seen a coronation of the Virgin at the apex of the

gable; two angels and two seraphim are placed at the sides of Christ and his mother. At the right portal of the facade of the cathedral of Sens (14 th century) is sculptured a coronation of the Virgin; angels are placed in the voussoirs.

In these different representations the Virgin is seated at the right of Christ, and nearly always on the same seat. She joins her hands and slightly inclines her head; Christ himself places the crown on the head of his mother, or blesses her, while an angel from a cloud brings that crown. Two angels erect or kneeling, holding torches, are present at the divine scene. At the red doorway of Notre Dame of Paris, there are a king and queen kneeling at the side of the personages, probably S. Louis and his wife the queen. We shall have occasion to review these sculptures in Art. Vierge Sainte.

COURTILLE. Garden.

An old word meaning a garden. (See Sauval, Antiquities de Paris. Vol. I. p. 67).

COURTINE. Curtain. Wall.

A defensive wall bearing battlements and a gallery, connecting two towers. (Old French Poem).[1]

Note 1.p.368. Roman de Garin le Loherain. Vol. I. pa 169. Edit. Techener. 1833. Ducange thus explains the word "oleoira", the gallery that serves as the upper defense of the curtain. (Latin text).

The curtains of fortifications of the Romanesque epoch are thick and solid, composed of concrete with facing of cut stone, or more frequently of small roughly cut rubble, the gallery is wide; sometimes even these curtains were terraced, and their height including the battlements rarely exceeds 19.7 ft. from the external ground,or the bottom of the ditch. From the 11 th century the curtains were equipped with wooden defensive galleries at top. In the 13 th century the height of the curtains was increased, and we see them attain a height of 32.8 or 39.4 ft.in very strong places. They were then sometimes pierced by slots at their lower part, to see what passed at the bo bottom of the ditch and to send crossbow bolts at the assailants. The means of undermining being very perfected during t the 13 th century, slots pierced at the base of the curtains

were generally renounced, for their long openings indicated to the assailants the weak points of the wall. In the 14 th century the curtains again became solid at the base, and the entire defense was made at the top, which at that epoch was equipped with stone machicolations with parapets and battlements, covered or uncovered. When cannon began to play an important part in the attack of places, slots or embrasures were again pierced at the bases of the curtains to sweep the bottom of t the ditch. Then about the end of the 15 th century, the curtains were terraced inside, as much to resist breaching batteries as to place the artillery at the level of the galleries. In the 16 th century were frequently arranged before the curtains and at the level of the counterscarp of the ditch, external ways with battlements, suited to receive crossbow men to sweep the glacis of the ditch. Romanesque curtains have their external faces vertical and without batter to make scaling m more difficult. About the end of the 12 th century, frequently the curtains have slightly pronounced slobe at the base, as much to prevent the approach of rolling towers as to place t the assailant directly beneath the wooden defensive galleries. This method is followed during the course of the 13 th century. When the stone machicolations replaced the wooden defensive galleries, the constructors traced the section of the curtains so that projectiles falling through the holes of those machicolations, struck the batter at about 10 ft. from the g ground; them rebounding on the slope of the glacis, struch the assailants obliquely, thus killing and wounding a greater number, than if they had fallen vertically. To resist balls a batter was given to the faces of curtains about the end of the 15 th century, and since then until recent times this method has been followed. (Arts. Architecture Militaire, Bastille, Chateau, Creneau, Donjon, Hourd, Machicolis, Siege).

COUVERTURE. Covering. Roofing.

A covering of stone slabs, tiles, slates or lead, intended to protect vaults or carpentry of an edifice from rainwater. (Arts. Ardoise, Charpente, Dallage, Plomberie, Tuile).

COUVRE-JOINT. Batten.

A simple or moulded strip of wood covering the joints of a

ceiling or wainscoting composed of boards assembled by laps, tongues or butted, for wooden vaults or internal woodwork. Fig. 1 gives several sections of battens of ceilings under a roof.

COYAU. Furring. Block.
A little piece of wood nailed at the ends of rafters to lessen the slope of the roofing at the point where it is placed on the cornice. Fig. 1 presents at A facings placed at the f feet of the rafters of a wooden roof. The furrings have the advantage of separating the junctions of the principals and rafters with the tiebeams B and the blocks C as well as the plates.D. They prevent these different timbers and their joints from decaying by contact with the stone, by allowing air to circulate around them. (Art. Charpente).

CRAMPON. Cramp. Anchor.
A piece of iron or bronze connecting two stones together. Fig. 1 is one of those iron cramps set with lead so frequently employed in the structures of the 13 th century; they take then the places of through anchors; they are generally of iron 0.8 × 1.2 ins. with lengths of 11.8 to 15.7 ins. (Art. Chainage).

CREATION. Creation of the World.
The creation of the world i frequently represented in sculpture on the portals of churches of the 13 th and 14 th centuries, and in glass painting. We have stated elsewhere (Art. Cathedrale), that the great churches built at the end of the 12 th century and the beginning of the 13 th by the bishops of France in place of the old Romanesque cathedrals, to contain a great multitude of believers, and to offer the people of cities vast covered areas suitable for assemblages, civil, political or regilious, were covered by sculptures and paintings on glass, which represented the scenes of the Old and New Testaments, prophecies and legends, and presented to the multitude a veritable encyclopedia of the state of human knowledge at that epoch. Naturally the creation, zodiacs, labors of the year were not forgotten, and are most frequently sculptured on the portals of cathedrals. One of the most remarkable

representations of the creation is cut in the voussoirs of the great opening on the right of the western facade of the cathedral of Laon (beginning of 13 th century). The subjects commence at the left; the first (1) represents God thinking of t the work to which he is going to devote himself; he seems to count the number of days required for him to complete his work. In the second compartment, placed over the first, God creates the celestial hierarchy; in the third he separates the land f from the waters, in the fourth he forms the heavens, in the fifth the earth, under the form of planets; in the sixth, he creates the fishes and birds; in the seventh men and quadrupeds; in the eighth, God is seated and sleeping with his head leanong on a stick. The ninth subject represents the angels and men adoring God; they appear to admire his work. The tenth s subject indicates human destiny. A personage of great height and crowned holds on his knees two other small persons, also crowned, who worship him. Two angels bring crowns at the right and left of the principal personage; these are the elect sheltered in the bosom of God. Beneath his feet a great demon's head devours a nude man, this is hell and its victims. Very beautiful reciefs are seen, representing the creation, on t the substructures of the left portal of the cathedral of Auxerre (end of 13 th century). The subjects of the creation are found sculptured at the cathedral of Rouen on the portal of the library (14 th century). At Chartres and Rheims are also found a beautiful series of the same subjects sculptured beneath the voussoirs of the portals.

CREDENCE. Credence. Table.

Tables or tablets placed around altars to receive various articles required for the sacrifice of the mass. Thiers [1] says that in his time most altars of cathedrals had no credences, but that "those of other churches possed them, some two, one at the right and the other at the left; several altars had o only one on the right, i.e., on the epistle side." He adds:- "Only the credence on the epistle side serves for placing the chalice, the cruets, the book of the epistles and gospels, etc. That on the left serves for nothing, unless to produce symmetry, or at most to place some candlesticks and flowers." In t the middle ages, when the love of symmetry was not carried to

the point of placing furniture, a table or cupboard opposite each other to satisfy a vulgar mania, men simply followed the primary rubrics of the Roman missal, that only desired a credence at the epistle side, also they suggest that this might be omitted if there was a window, a recess for support near the latar, where could be placed the hand bell, cruets, basin and towel, that served during the mass.[1] "The ceremonial of t the bishops," continues Thiers, "also requires but one, no more than Gavantus, the other ceremonials and the other rubrics; yet they say that one should only use these at solemn masses, and not at other masses. But anciently credences were known neither to the Greeks nor the Latins." Anciently is a little vague, and we find credences above the piscinas or beside them in churches built in the 12 th and 13 th centuries on the epistle side. (Art. Piscine). These credences often have the form of little cupboards and are little recesses cut in the wall with a table of stone in front. Yet here is a credence from the middle of the 13 th century, that is found placed in the arcade of the chapel of the Virgin of the cathedral of Seez, Fig. 1. The tablet projects little and is furnished with a little ledge as indicated by the section A; but the place occupied by it is well marked and richly decorated. In the 15 th century the credences near altars are sometimes composed of a little pier or column supporting a circular or polygonal table (2). But those examples are rare, for most of these objects were destroyed, when in the last (18 th) century men had the sad idea of ornamenting the chapels of our c churches by woodwork painted white and gold, as done then for boudoirs.

Note 1.p.372. Diss. sur les princ. aut. des égl. Chap.25. 1688.

Note 1.p.373. Latin note.

CRENEAU. Crenelle. Embrasure. Slot.

By the word "cneneau" (crenelle) is now only designated the opening made in a parapet to permit the defenders of the walls to see the assailants and to launch projectiles. But in the middle ages by this word was understood every opening made at the top of a tower or a curtain, covered or uncovered, and w which served for defense. We resume the name employed during

the middle ages, and we shall speak of battlements covered or uncovered, open or closed by shutters. Let us first state that the solid intervals between the openings are merlons, for there are no openings without merlons, just as there are no windows without piers.

Yet it is certain that in the middle ages the name was given indifferently to openings left between the merlons or to the merlons themselves. (Old French poem).[1]

Note 1.p.374. Roman de Renart. Verse 22,579 et seq.

"Camel" is here evidently the merlon, for one cannot lean against the opening. However that may be, and since we take as much as possible the names generally adopted, it is understood that for us the crenelle is the opening and merlon designates the solid between them.

The dimensions of battlements being given by the height of a man, those dimensions vary little; the merlons are always nearly 6.6 ft. in height, to be able to completely protect the defenders; the sills of the crenelles are 3.3 ft. from the floor of the gallery, and their width varies from 3.3 to 2.3 ft. As for the merlons, they are very variable; we shall see why.

The crenelles crowning Gallo-Roman fortifications are generally pierced in parapets of great thickness, about 1.6 ft., built of rubble and brick, crowned by a coping slab forming a projection all around the merlon as indicated in Fig. 1. The merlons then only have a width sufficient to conceal a single man. These arrangements were determined by the system of defense of that epoch. It does not appear that the Romans employed the hand crossbow, they had archers and slingers, and each defender being equipped with one of these arms had his merlon for placing himself under cover, while he prepared to shoot. It was then natural to multiply merlons and crenelles as much as possible. The ancient walls of the city of Pompeii, built under the republic, and which are more Greek than Roman, present battlements where each merlon is furnished with a stone cross wall to protect the archer from arrows shot obliquely. Thus each archer possessed his little cell pierced by a crenelle.(1 bis). This system of battlements does not appear to have been followed by the Romans under the empire; they were satisfied with the battlements sketched in Fig. 1. Until about

the end of the 11 th century, it does not appear that sensible modifications were made in those Roman battlements. At that epoch expeditions to the East made known means of defense and of attack relatively very much perfected. The Byzantines and consequently the Arabs possessed war machines that drew the a admiration of western men at the same time, that they cast t terror into their ranks, the walls of their strong places were well equipped and well defended. Thus after the first crusades we see in the West the system of the upper defense of towers and of walls is entirely modified. Not only is changed the system of battlements, but it is combined with the system of movable machicolations known under the name of defensive galleries.(Art. Hourd). the merlons are made wider, the crenelles become larger, and between them in the middle of the m merlons are made narrow openings (slots) for firing the hand crossbow; with great care are avoided those projecting slabs that crowned the antique merlons, for those projections facilitate scaling, or give a hold for the grappling hooks, that t the assailants cast on the tops of the walls to overthrow the parapets. The oldest battlements known to us in France, built after the crusades, are those crowning the towers and curtains of the castle of Carcassonne (end of 11 th or beginning of 12 th centuries). They are intact: here is the detail. (2). Here holes are already pierced in the merlons for firing the crossbow; these are narrow slots, splayed inside in arched f form. These merlons are thick, built at the angles of cut stone and dressed rubble. Openings of the defensive galleries are pierced at the level of the floor of the gallery, and also a little below the sills of the crenelles, the lower holes to receive struts to relieve the overhanging beams passed through the upper holes.(Art. Hourd). The defensive gallery being placed, its floor then found itself at the level of the s sill of the crenelle, thus the merlons are sufficiently high to allow a man to pass upright through the crenelles, as by as many doorways, so as to post himself in the defensive gallery. In time of peace, the battlements of the curtains of t the castle of Carcassonne were not covered, while those of t the towers were at all times covered by permanent roofs. The plates of these roofs passed along on the tops of the merlons and formed lintels (Art. Tour). The towers always commanded

the curtains, but being placed in communication with their g galleries by well ironed doors and stairs, the battlements w were were extended to protect men on these steps, as indicated in Fig. 3, taken from the defenses of the same castle of Carcassonne.

Oriental influence is singularly pronounced in the battlement of the 12 th century still preserved on a part of the south transept of the cathedral of Beziers. One knows all the importance of Beziers acquired at that epoch; it was defended by powerful walls, whose colossal ruins still are to be seen. The cathedral was built at the summit of the city, and was p provided with an enclosure, and was itself a veritable citadel. The south transept commanded the entire cloister, whose external walls had battlements. Then see now this transept itself had battlements, on two projecting buttresses that strengthened its two angles was erected a parapet pierced by flanking slots. Such is the plan (4) of this crenelated parapet. It is seen that the five slots are drawn so as to send divergent projectiles. In the interior these slots are splayed with arches like those of the castle of Carcassonne. Here (5) is t the external appearance of this crenelated parapet, with the beautiful quasi-oriental cornice on which it rests. The internal floor is at the level A, and the projecting head of a gargoyle carrying the water from the gallery. From the floor of the gallery to the cornice B there is a height of 4.1 ft.; b but it is necessary to know that this battlement so dominates the exterior, that the men placed behind it, although their heads were above the cornice B, were perfectly masked from the assailants placed below. The four slots C (see plan, Fig. 4) are very plunging, while that at D is not so, and indeed this slot could only serve to look outward and very far from the foot of the monument. The distance separating the floor of t the gallery from the great lower cornice is necessary for the archers to be free from the projection of the cornice, which is sufficiently indicated by the section (6) made on the axis of one of the slots C of the plan. Between the two buttresses very certainly existed a parapet with crenelles, that is unfortunately destroyed. It should not be forgotten, that in the cathedral of Beziers, this crenelation is at the same time t the ornamental cornice of the religious edifice, which explains

this richness of mouldings, this upper moulded coping, that is not found in the military structures of that epoch. In t the 13 th century the crenelles are evidently constructed after a formula given by experience. The merlons are 6.6 ft high by at least 5.6 to 10.8 ft at most wide.with 1.5 ft. thickness; the sill of the crenelles is 3.3 ft. from the floor of the g gallery, and their width is 2.3 ft. At the middle of each merlon is pierced a slot. The system of definse is studied with minute care.

Assume (7); at A is the external face of the battlements, at a are the slots, that have an opening not over 2.8 to 3.2 ins. wide, at b are the holes for the defensive galleries pierced at equal distances, so that the sills resting on the b beams may be cut with equal lengths beforehand; at B is the plan of the crenelation with its slots, which have a splay of 15.7 to 17./ ins.• at C is the section of a crenelle, at D is the section of a slot, and at E is the internal face next the gallery. The sill of the slot is always placed in a course below the sill of the crenelles, and (see the section D through the slot) the bottom of its plunging slope reaches a course b below the holes for the defensive gallery, so that the defensive gallery being placed, the crossbow men can shoot on the asrailants below the floors of this gallery. The bottom of the slots is cut as indicated by the sketch G, so as to give more breadth for shooting without exposing the crossbow men. One s sees that the detailr are combined with the greatest care, th the constructors rigorously observe the same methods with very small differences during the course of the 13 th century. These are battlements and curtains uncovered in time of peace, and covered only in case of war by the roofs of the defensive galleries.(Art. Hourd).

As for the battlements of covered towers in the 13 th century, with battlements beneath the roof, here is how they were arranged (8). The walls are 3.0 ft. thick, the crenelles have a sill A, so as to allow the defenders to see outside, these crenelles are furnished outside with two hinged shutters falling into rebates, like the upper parts of the ports of a war vessel, the lower shutter swings by means of horizontal pivots in two iron hooks, not closed, so that it will be easy to remove it in time of war, when the defensive galleries are fixed;

for then the defenders pass through the crenelles as through doorways to take position on the defensive galleries. The upper shutter is supported by two hinges C fixed in the rebate a and opposite each other, these shutters are permanent. If two shutters were placed outside these crenelles instead of one, that was to render more easy the removal of the lower shutter, that a man can remove from within, as we have found, again it is that in case of attack, the defensive galleries not being placed, to protect the defenders from projectiles shot upward from outside, which does not prevent them from having air and light by leaving the upper shutter partly open. Even if one only leaves the lower shutter partly open, he can shoot on t the man placed below the towers without exposing himself. This system of shutters is adopted for crenelles placed in the parapets of curtains beside the dooruays in the towers giving entrance to the galleries.(9).

This precaution was necessary to protect perfectly the men, that waited in the gallery, for one to open to them the door in a tower after making themselves known. Thus are constructed without exception all the battlements of the towers of the city of Carcassonne, which date from the end of the 13 th century. Yet on the curtains of the same fortress near gate Narbonne, and that are earlier than the defenses built under Philip the Bold, are seen battlements much stronger than those of the 13 th century. It is true that this part of the city was that before which one could organize a regular attack. T These last battlements are then higher and thicker than the ordinary battlements of the curtains, and their internal surfaces next the gallery are built with a batter as indicated in Fig. 10. Each crenelle, by reason of the great thickness of the merlons, has a thinner wall beneath it. Although not covered, they were equipped with lower swinging shutters. The inclination of the internal surface seems to us to be made to permit the defenders to better flank the curtain, always leaving to the battlements an extraordinary force of resistance. Yet these defenses are light, if we compare them to those crowning the keep of the castle of Coucy.(Arts. Donjon, Hourd).

At the beginning of the 14 th century, the system of battlements of towers and curtains was entirely modified anew, for the wooden defensive galleries, frequently burned by the besiegers, were substituted stone defensive galleries, frequently

i.e., machicolations, and instead of leaving battlements recessed, they were made to project beyond the face of the walls, at the ends of corbels or arches forming machicolations. One of the oldest examples of this mode of construction and one of the most curious, in that it employs both arches and corbels to support the battlements and form a series of machicolations, is seen in the western facade of the cathelrad of Beziers, fo fortified in the 12 th century, as we stated above, repaired, partly rebuilt and fortified at the beginning of the 14 th c century. (Art. Machicoulis).

When making the crenelated parapets overhang the external walls, the constructors of the 14 th century gave the mouldings of the crenelles a new form intended to better protect t the defenders. It must be stated that the crenelles only served to cast stones on the assailants, the crossbow men or archers placed themselves behind the merlons, and discharged their arrows or bolts through the long slots. Now about the middle of the 14 th century, the armed besiegers were accompanied by very numerous bands of archers and crossbow men, and when the ramparts were attacked by mining, or it was desired to scale them, they covered the battlements with projectiles, to prevent the besieged from showing themselves. The old crenelles with their sides returned at right angles caused arrows to deviate, when they even wounded the defenders concealed behind the merlons. To avoid that inconvenience, the architects gave the crenelles pronounced external splays, and moulded these splays to prevent rebounds.

Fig. 11 explains the details of the defense; A is the section of the sill of the crenelle, at B is seen the lower moulding, and at C the upper round, which stops the arrows and bolts, preventing them from penetrating behind the parapet by rebounding. The defenses established in the 14 th century before t the western facade of the cathedral of Beziers form a moulded crenelation, moulded according to this system.

We indicate in Fig. 12 the external face of the crenelated parapet, which is placed on an arch in front of corbels forming four broad machicolations that open over the central rose window.

Fig. 13 presents the section of this battlement; the arch is at A, the machicolations at B, with their corbels at C, and t

the projections D, designed to prevent arrows from ascending through the holes of the machicolations by rebounding, the s section is made through the sill to the middle of the crenelle.

Fig. 14 reproduces the appearance of merlons from the interior, with the slots richly moulded at top. The crenelated parapet is here entireln independent of the corbels, that form machicolations, as shown by the section in Fig. 13 and the external perspective.

Since then the crenelles in defenses built with care, were furnished with these mouldings intended to prevent rebounds. Only it frequently occurred in the 15 th century, that the m mouldings with their splays could extend around the merlons, as indicated by Fig. 15. Sometimes at the end of the 15 th a and the beginning of the 16 th centuries (for battlements persisted long after the invention of cannon), the merlons were decorated by sculptures, shields of arms, and medallions, as on the tower of gens d'armes at caen and on some castles of the epoch of transition. Still when the use of cannon became general, men sought to modify the battlements so as to resist the new projectiles and to allow crossbow men to use them with advantage. It is not in the French feudal castles that must be sought these improvements. The French nobility long protested against the use of gunpowder, it yielded only very late to t that ne. force, while on the contrary the free cities profited by it with enthusiasm. In the North, Switzerland, the old German cities, i it necessary to study these improvements introduced in the details of fortification while the use of artillery became more general.

One still sees at Basle a battlement on the advanced work of gate S. Paul, from the beginning of the 14 th century, that has retained its slots arranged for crossbow men. This battlement is supported on false machicolations, that are merely a decoration there (16). The merlons are very thick and are pierced by wide slots fitted with stone cylinders rotating about two vertical pivots, so as to entirely close the slot while the soldier loads his arm.

At A is traced the plan of the merlon; at B the stone cylinder of the slot is turned to permit shooting, at C being so as to mask the opening. These merlons are otherwise very narrow , and are equipped with mouldings to prevent balls from rebound-

rebounding. There exist embrasures of this sort in the fortifications of Nuremberg preceding those erected by Albert Dürer. (Art. Embrasure). One also sees on the curtains connecting the great circular bastions built by that skilful artist around the same city, battlements arranged for cannon and for crossbow men, that meeit being mentioned here, they are pierced in a very thick parapet, the slots are composed of a round hole with the sight above, the embrasures are fitted with pivoted shutters pierced by a hole for sighting before unmasking the muzzle of the gun.(17); the gallery is entirely covered by a shed roof. Several curtains of Nuremberg are equipped with wooden battlements placed above the parapets and pierced by embrasures for guns, as indicated in Fig. 18. Evidently these wooden battlements, that recall the defensive galleries of t the middle ages, were foreseen in the construction of the curtains, for the rounded glacis in which are pierced the embrasures are equipped with stone corbels intended to support these battlements in half timber work.

At the beginning of the 16 th century were often seen curtains and ramparts reserved for great cannon, while the battlements for the crossbow men were pierced in the parapets below the crowns of these great works. Thise lower crenelated parapets then take the name of advanced work.(Art. Architecture Militaire).

The towers commanding the walls of Nuremberg, erected by Albert Dürer, are crowned by wooden battlements with shutters d designed to protect the artillerists that served the guns of small calibre mounted on the upper platform. (Art. Tour). At the top of the watch tower of the castle of the same city is still seen a complete wooden battlement under the roof, with shutters rising inside.

Here (19) is a perspective view of one of these crenelles f from the interior. At A a geometrical section shows the shutter raised with its hook. In France we are not so good in preserving, we have destroyed all those upper works in wood of o our fortifications of the end of the middle ages. Ten years s since at Langres were found some remains of the parapets in half timber work from the beginning of the 16 th century, which have many relations to what we give here; but Langres having suffered a complete restoration, those old wooden galler-

galleries have disappeared to give place to parapets as high as the waist, with the regular sill coping slab.

CRETE. Cresting.

This name is given to the ornamental crowning of the roof. It was said that a roof in the middle ages, that it was crested, when its roof was crowned by a cresting of stone, terra cotta or metal.

During the Romanesque period, the roofs formed a very obtuse angle at the top conformably to the antique method. If the edifice had a tunnel vault, the covering of stone slabs or t tiles was placed directly on the extrados of the vault, and a stone cresting covered the junction of the two slopes of the roof; this cresting was often decorated by openings, as may still be seen in most edifices of Auvergne. Even later (in t the 12 th century) perforated stone crestings were placed on the top of carpentry. Several reasons were the motive for the use of this sort of croyning. At first most carpentry was without ridge-beams and purlins, it compresed only a series of spaced rafters; it was then necessary to give a bearing to t these rafters not connected together, by means of a load placed on their upper ends. It was also necessary to cover the last tiles by crestings, that were heavy enough to not be overturned by the force of the wind, and wide enough to prevent rain or snow from passing betweeu the two slopes of tiles.

Everyone can see how on thatched roofs the peasants make a wide cnesting of mud, in which they set grasses to retein the earth and prevent it from dissolving in rain.(1). The origin of crestings on roofs is found in this naive procedure.

On the coverings of edifices covered by tunnel vaults in A Auvergne and the southern provinces of France, may yet be seen perforated stone crestings, which are very elegant. Here are (2) several models; these crestings are placed directly on t the vault as indicated at A. At the top of the apsidal chapels of Notre-Dame-du-Port at Clermont, there exist terminations by crestings perforated in slabs, that start from the top of the cone formed by the stone slab covering of those chapels and rest against the wall of the side aisle.(3). In the provinces where tiles were generally employed for coverings, as for example in Burgundy, the crestings of roofs are composed

of a series of terra cotta crestings more or less decorated. (Arts. Faitiere, Tuile).

It is only on roofs covering vaults that were placed stone crestings; sometimes (especially during the pointed period) are seen crests carved on the tops of buttresses crowned by gables. Examples of these crests are found crowning the tops of the buttresses of the nave of the church of Notre Dame of Dijon (4). (Beginning of the 13 th century). There animals a are combined with foliage, irregularly arranged. later during the 14 th and 15 th centuries, this sort of crestiug consists of regular ornaments terminated by leaves.(5).

On carpentry covered by slates or metal were nearly always set crestings of lead after the 12 th century. The presence o of these lead crestings was even motived by the combination i itself of the carpentry, which as we have just stated, consisted of rafters not connected together by ridge beams and purlins. The weight of the lead cresting placed at the tops of t these rafters ensured their stability. Of crestings of lead on edifices before the 15 th century remains no trace' their presence can only be proved by reliefs, vignettes of manuscripts, and on shrines made in the form of little churches. To these objects of goldsmith's work it is necessary today to go to seek models of crestings in metal of the 12 th, 13 th and 14 th centuries, and those models are numerous. However, if o one derires to use these goldsmith's crestings to apply them to monuments, account must be taken of the difference in scale, of the design to be modified in consequence. Some cresting of a shrine with a height of 2.0 to 2.4 ins, that produces a good effect, would become heavy and massive if one were pleased to increase it to 3.3 ft. in height. Experience alone can indicate the dimensions and proportions, that must be given t to decorations outlined against the sky. Some ornament that seems well composed and proportioned in the studio is ungraceful heavy or confused, placed at the heeight of 98.0 ft. and detached in outline against the sky. For example, in that position it occurs that the delicate parts are devoured by the light, and on the contrary the solid parts are made heavy by losing their details. Broad designs, well accented, easy to seize and simply modeled, are those that produce the most satisfactory effect. Besides, for this sort of decorations to be

understood, it is necessary for the same design to be repeated a great number of times. Then it is necessary in composing these perforated crestings to think of the extent to be occupied, the greater or less development affecting their composition. If the cresting be developed only for a length of some yards, it is necessary to choose, for balustrades, a close design in which the ornaments approach the vertical; on the contrary, if the cresting occupies a long ridge, it will be necessary to broaden the composition of the design.

Crestings of metal that exist on roofs covered with lead or slates were absolutely similar in the 1m th century (so far as can be judged by the examination of reliefs) in style, and those crowning the shrines of that epoch; they appear to have assumed in dimensions the richness of great importance about the end of that century. It is useless to insist on the composition of the designs, that conform to the perfect taste of that time. We give (6) one of those crestings.

About the middle of the 13 th century, metal crestings are transformed like all monumental ornamentation. Men abandoned the last traditions of designs brought from the East to adopt the native flora.(7). These lead crestings were generally pretty high, and also proportioned to the dimensions of the roofs; for a roof 39.4 ft. high the cresting should not be less than 3.3 ft. above the ridge. Iron frames were necessary to support the lead hammered sheets, that composed the cresting. These frames, as we have previously stated, fixed in V form on strips connecting the ends of the rafters, thus maintained these rafters in their horizontal planes and prevented the warping of the carpentry. Fig. 7 gives the iron framework of the preceding cresting. This framework being fixed, the ornaments in two shells beaten out by the hammer, were soldered together, after taking care to lay the coverings of the ridge on the strips A A. These procedures are still employed today. It was always necessary to compose these designs so as to permit a c combination of the iron dramework both simple and solid, if this framework failed, the lead cresting was leftto its own weight, and did not delay to collapse. Crestings preceding the 15 th century probably did not last long; it must be believed that the frameworks intended to maintain them were insufficient or fixed with little care. Struck by the inconvenien-

inconveniences connected with the system adopted after the 12 th century, the architects of the 15 th centurycomposed all their crestings like balustrades, i.e., with a horizontal irom rail serving to crown the selected design. Thus were composed the crestings of the roof of the S. Chapelle of Paris repained under Charles VII, and the ridge of the tower S. Romain belonging to the cathedral of Rouen (8); several of t those of the old abbey of S. Ouen of the same city, that of the chateau of Meillant, etc. The latter compositions of crestings form actual lattices of wrought iron covered with ornaments of hammered or cast lead; but these designs are far f from having the breadth and firmness required by decorations placed at a great height and outlined against the sky; they are thin and with details at too small a scale, lost at the distance at which one can see them. The crestings of that epoch are often decorated by heraldic arms or monograms, and if they occupy great length, at certain distances the ends of p principals extending above the rail contribute to their stability. The cresting of the S. Chapelle at Paris is composed thus of bays comprising three great fleurs-de-lis between pinnacles covered with lead. There exists at the Imperial Library a drawing of this cresting. In our opinion, crestings crowned by a horizontal railing and in great part composed of straight lines are far from producing the effect to be sought in this kind of ornaments, which require a certain freedom in drawing forms derived from plants; one would think of a balustrade placed on top of a ridge.

The epoch of the Renaissance produced crestings of pretty design; some of them still exist; those of the cathedral of Clermont and those of the church of S. Wulfrand of Abbeville may be cited among the most beautiful and most complete. We p possess in our portfolios a drawing of a beautiful cresting of that epoch of the Renaissance, that we think came from the chateau of Blois. The drawing dates from the beginning of the 17 th century; we reproduce it here (9). It consists of a series of Fs and balusters connected by cords, above the upper horizontal railing is a crowning composed of fleurs-de-lis a and scrolls; four bays of Fs are comprised between pilasters A terminated by spindles. A very rich coping serves as base for this cresting and covers the slates.

Men crowned by lead crestings the slate roofs of public edi- fices and those of houses even toward the end of the reign of Louis XIII. Dating from the reign of Louis XIV, they avoided giving importance to roofs and even sought to disguise them; consequently there was no longer any reason to ornament what one pretended to conceal. The lead work that crowns the roof of the chapel of Versailles is one of the last made with art. At the beginning of the 18 th century, that beautiful indust- ry of wrought and cast lead work was lost, and men scarcely knew how to solder at the end of the last (18 th) century. (Art. Plomberie).

CROCHET. Crocket. Volute.

The name given today to these ornaments terminated by bunch- es of leaves or by rolled buds, so frequently employed in the monumental sculpture of the middle ages after the 12 th centu- ry. Crockets are seen in friezes, and capitals, on the rakes of gables or gablets, in the hollows of archivolts between l little columns combined in clusters. The 13 th century espec- ially adopted this ornament; it used this with some skill. In Art. Sculpture we have tried to explain the origins of most of the sculptured ornaments of the architecture of the middle ages; here we shall content ourselves with making known to o our readers the different transformations of the crocket from the moment, that it takes a place in decoration until the mom- ent, when it entirely disappears from architecture.

We already find the germ of the crocket in the upper corni- ce of the nave of the church of Vezelay, i.e., in the first v years of the 12 th century. (Art. Corniche, Fig. 4). The inter- nal capitals of the nave of the same church also show us in place of the antique volute leaves recurved on themselves, t that already are actual crockets (Art. Chapiteau, Fig. 8). Y Yet it is in Ile-de-France and on the banks of the Oise, that the crocket assumes an important place in ornamentation from the middle of the 12 th century. The first crockets appearing beneath the crowning slabs of the cornices already decorate certain churches built from 1150 to 1160. They are small with heads composed of three recurved leaflets quite similar to the colyledons of the young plant. The stem from which these lea- ves spring is wide and swelled at base, so as to attach itself

to the moulding serving as base of the ornament.(1). About 1160 the crocket appears well characterized in the capitals; the choir of Notre Dame of Paris, erected at that epoch, is surrounded by cylindrical piers whose capitals no longer have anything of Romanesque sculpture. There are leaves starting f from buds, scarcely developed, and at the angles are crockets with broad stems, powerful, with heads composed of leaflets r recurved on themselves, plump and modeled with charming flexibility (1 bis). These leaflets soon give place to leaves; the head of the crocket develops relatively to the stalk; that is divided by longitudinal angles like the stem of celery. If t the crockets are placed in the hollow of an archivolt, it frequently occurs that the base of the angular stem is accompanied by a leaf with its stipules well developed and adhering to this stem (2); which imparts grace and particular firmness to this sort of ornamentation.

At the end of the 12th century, the crockets on capitals often take the important place, they represent the angles of the abacus; they project beyond the middle portion of the bell; they are divided into separate leaflets, bend and coil like a bud commencing to develop. It is evident that sculpturs have abandoned the last traditions of antique sculpture, and that they are inspired by plants, whose development they observe with minute care, as well as the charm of appearance, yet without restrincting themselves to a servile imitation.

We give (3) several of these crockets already developed in buds, from the end of the 12 th century; A comes from the sacristy of the church of Vezelay; B is from the choir of the same church; C is from the portal of the church of Montreale; D from the choir of the church of Eu, E from the choir of the cathedral of Soissons. All these crockets adhere to the capitals, and it is only after that epoch that this ornament is f found around the bells, almost without exception. When these piers are composed of clusters of columns leaving at intervals a few inches between them, the head of the crocket is frequently placed between the capitals, and has two stems; this is a skilful means of avoiding disagreeable intersections, and to not interrupt the band of sculptures presented by these capitals.

Here (3 bis) is an example of these crockets with double s stems taken from the piers of the church of Eu.(Art. Chapiteau).

At the origin of its development the crocket presents the greatest variety in the composition of the heads and the decoration of the stems. One frequently sees in edifices that date from the end of the 12 th century and the beginning of the 13 th centuries crockets on capitals or in archivolts terminated by human heads, their stalks are terminated by leaves or animals. The porch of the church of Notre-Dame-de-la-Coulture at Mans is covered by an archivolt that presents a beautiful collection of this sort of crockets (4). It often occurs that an animal sometimes replaces this ornament, while retainiug its characteristic outline.(5). Thus one sees crockets, whose heads reproduce the form of a flower (6).

About 1220 the crocket no longer presents a developed bunch of leaves, but always scrolled on themselves' the imitation of nature is more exact, the mass of the head is less rounded a and enlarged at the expense of the stalk. The archivolts of the great openings of the towers of the cathedral of Paris p present perhaps the most beautiful examples of this sort of sculptured decoration.(7, 7 bis). In Ile-de-France from 1220 to 1230, the architect abuses the crocket; he places it everywhere, and especially uses it to break straight lines detached against the sky, like the angles of spires, the external piers of towers, as one can see at Notre Dame of Paris and on the t tower of the cathedral of Senlis. In this case the crockets are placed at a great height, they are composed of a simple head terminating a stem with a single midrib (7 ter). It is understood that each crocket is comprised in the height of a course. About 1230 this vegetation in stone seems to expand, as if time acted on these monumental plants as it acts on living plants.

The archivolts of the entrance of the chapter hall of the cathedral of Noyon are decorated by a double row of leaf crockets, which are perhaps the most developed of that epoch and the richest in sculpture. (8).[1]

Noet 1.p.408. This beautiful hall has just been restored by the care of the Commission of Historical onuments dependent on the ministry of State, and under the direction of M. Verdier. One can say that this magnificent example of the architecture of the 13 th century has been saved from ruin.

The school of Burgundian sculpture is distinguished among a

all others in the composition of the crockets. This school n nad given from the Romanesque epoch to sculptured monumental decoration an amplitude, boldness and power, a warmth of modeling, which in the 13 th century, when sculpture acquired mo more strength in the imitation of the local flora, must produce the most brilliant compositions. Thus the crockets sculptured on the monuments that date from the middle of that century present very remarkable exuberance of vegetation.(9, 9 bis).[1] The Norman and Anglo-Norman school perhaps excels the Burgundian school; it exaggerates the ornamentation of the c crocket, as it exaggerates all details of Gothic architecture arrived at its development; but less scrupulous in its imitation of the flora, it knows not how to retain in the sculpture of ornament that strength and variety, which charms in Burgundian sculpture. All Anglo-Norman crockets of the middle of t the 13 th century resemble each other' in spite of the efforts of sculptors to give give them relief, and surprising modeling, they seem confused, and at a distance produce no effect, because of the defect of masses of heads too much recurved and the extreme smallness of the stems. We give (9 ter) one of these AngloNorman crockets taken from the cathedral of Lincoln.

Note 1.p.409. From the facades of the church of Vezelay and of S. Pere-sous-[illegible].

Yet the heads of crockets gradually tend to become modified; those leaves and recurves, enveloped as they were at first in a uniform mass, straighten and grow, so to speak, extending on the bells of the capitals, and beneath the mouldings of friezes. At the S. Chapelle of Paris (1240 to 1245), are already seen heads of crockets that have become groups of leaves, mingling and running beneath the bells; petioles leave the ribs and the stems (10), while in the great crowning friezes the crockets still retain their monumental and symmetrical character until the 14 th century (11).[1] On the rakes of gables crowning the windows, from the middle of the 13 th century, along the gables of edifices, were placed crockets inserted in grooves in the copings forming the covering. (12). It is certain that these stone sculptures inserted along the copings of the gables and maintained at certain distances by T-anchors, as indicated in Fig. 12 bis, would not have a very long duration;[1] but they could also be easily replaced in case of accident or

of deterioration caused by time. It is unnecessary to see in the crockets of the rakes of gables more than a decoratiou an analogous to those antefixas or open crownings, that the Greeks also set in grooves in the facias of pediments. We have frequently heard blame to the architects of the middle ages f for this attached ornamentation because of its fragility; it is necessary to be just and not approve that of the Greeks. The Gothic architecture daily became more elegant and refined; the rounded heads of the crockets were regularly spaced along these inclined planes but soon appear heavy, however delicate they are. These ornaments are recusved on themselves, falling on their stems, oppose the ascending lines of the gables. In 1260 men already renounced their use, and they were replaced by bent leaves, ascending the inclined openings of gables, r rising at certain distauces to form an indented line. It may be admitted that this sort of crockets was first applied to the gables of the portal of Rheims, and to that of the red d doorway of the cathedral of Paris, structures erected from 1257 to 1270.(13). Crockets with round heads remain on the l little gablets of pinnacles, arches and shrines, because it would not have been possible to sculpture ascending leaves of very small dimensions. It is understood, that these little cr crockets are of very simple form; we give here (14) several examples at half full size.

Note 1.p.411. From the south tower of the facade of the cathedral of Amiens.

Note 1.p.412. But one still finds a good number of crockets of the 13 th century attached to the copings of gables.

At the cathedral of Beauvais, we see crockets on the angles of the pinnacles of the choir that take a particular form, th these crockets were sculptured about 1260, they recall certain water leaves, and are distinguished by their extreme simplicity (15). In general, crockets are like all sculptured ornaments of Gothic architecture, very projecting and developed when the nature of the material permits, meagre and projecting little, when the stone employed is friable.

During the 14 th century, crockets of the openings of gables or gablets take more amplitude, they conform in execution to the taste of the sculpture of that epoch; they become distorted or rumpled; they are less refined than those of the preced-

preceding century, but represent leaves rolled and massed on themselves (16). About the beginning of that century, they disappear from all cornices and mapitals. When these crockets a are of small dimensions, as for example along the angles of pinnacles, they are near each other, and frequently imitate the form of water leaves or of seaweeds. (17).

On the contrary in the 15 th century, the crockets of the copings of gables take a considerable development, are farther apart and are connected by leaves running along the copings; they adopt the twisted forms of the sculpture of that epoch. But particularly in Ile-de-France, their execution is broad, full of strength, freedom and flexibility, the leaves composing them are leaves of the thistle, granadilla, curly cabbage, parsley and geranium. (18). This kind of ornament belongs to the Gothic epoch, it is the necessary complement of the ascending forms of that architecture, it accompanies its rigid lines and destroys their dryness, either when these lines are o outlined against the sky or are detached from the bare wall, it gives scale and grandeur to edifices, producing effects of vivid and picturesque shadows and lights. When the Renaissance returned to what it believed to be the imitation of the a antique, the crocket no longer finds application in architecture. During the period of transition between Gothic and French Renaissance, i.e., between 1480 and 1520, one again finds the existence of rampant crockets. Some of them are very beautiful and finely wrought (19); such are those of the mansions of Cluny and de Tremoille, of the church of S. Germain-l'Auxerrois, the rood screen of Alby, the western facade of the cathedral of Troyes, of the church of Toul, etc. (For the general arrangement of crockets, see Arts. Chapiteau, Corniche, Fleuron, Gable, Pignon and Pinnacle).

Our readers will perhaps find, that we have given to a detail of ornament an exaggerated importance, but they will do w well to consider, that in this the sculptors of that epoch, t that particularly occupies us, have been creators, they have gone nowhere to seek models in preceding arts; nothing is like it in the Roman sculpture of which they possessed fragments, nor in the oriental sculpture, that they themselves saw and studied. If we have given a great number of examples of these crockets, it is because that we have always heard expressed by architects studying Gothic architecture the diffi-

difficulty, that they found, not only in composing and having executed this ornament, so simple in appearance but of such prominent character, and even in drawing the crockets that they had before their eyes. Further in a style of architecture, there is no insignificant detail, the smallest moulding, the most modest ornament, have an appearance participating in the entirety, an aspect that must be studied and known.

CROIX. Cross. Crucifix.

During the middle ages a cross of stone or metal was placed at the top of religious edifices, on the roads, at entrances of cities and in cemeteries. It is well to state first, that the image of Christ was not suspended on the cross until about the 6 th or 7 th centuries, until then the instrument of punishment, that became under Constantine the symbolic sign of t the Christians, was represented plain. In the catacombs of Ro Rome exist representations of the cross ornamented by gems, from the two arms are suspended lamps. But we do not think t that there exists a single painted or sculptured representation of the crucifix earlier than the 6 th century, and again from that epoch until the 12 th century, these images are very rare. (Art. Crucifix). We only have to occupy ourselves in this Article with crosses belonging to the architecture, which are attached to the monuments, or that themselves form little isolated monuments.

CROIX ATTACHEES AUX EDIFICES RELIGIEUX.

Crosses attached to Religious Edifices.

These crosses are of three kinds, crosses sculptured in stone, crosses of metal, and painted crosses.

The most ancient sculptured crosses nearly always have four equal arms; they decorate the tops of gables, tympanums of d doorways of churches, fronts of buttresses or piers; they are also sometimes found on capitals and the keystones of vaults.

The primitive cathedral church of Beauvais, known under the name of "Basse-oeuvre" (lower work) already existed in the ye year 990. That edifice appears to date in the 8 th century a and presents on its western gable a stone cross inlaid in the masonry, and ornamented by little cubical stones. That cross we give ( ), and it is chamfered at the edges and has a foot terminating in a point. The gable of the church of the priory

of Montmille, erected after the beginning of the 11 th century near Beauvais, is ornamented by an inlaid cross, that recalls by its form that of the Basse-oeuvre; but to the cross of Montmille is already attached a figure of Christ with a halo. (2).[1]

Note 1.p.419. See Archaeol. de l'ancien Beauvoisois, by Dr. Woillez.

From the 11 th century, chiefly in Berry, Nivernais and Auvergne are found crosses, no longer inliad in the tympanums of the gables of churches, but crowning their apexes. The western facade of the church of Ebreuil, that dates from that e epoch, still shows behind the tower of the 12 th century a cr crowning cross of stone, and of curious form. Here (3) at A is the front side, at B is the back and at C the edge. There is reason to admit that these crosses, detached against the sky at the tops of gables, were very common on the religious edifices of the Romanesque period; but the fragility of these thin perforated slabs, exposed to storms, must have quickly caused their destruction.

In reliefs of the 11 th and 12 th centuries, where the gables of churches are represented, the summits of towers are always terminated by crosses, most frequently with equal arms, placed on a ball or on a column rising from an ornament. The canopy that protects the seated Virgin of the tympanum of the portal of S. Anne at Notre Dame of Paris (12 th century) bears a cross of that kind at the base of its dome (4). At the end of the 12 th century the crosses serving as terminations of gables always have the foot longer than the other three arms, or they are supported by a sort of pedestal, that isolates th them from the gable; such is the curious cross found in the excavations made by M. Millet in the church of Notre Dame of Melun, when he undertook the restoration of that church. M. Millet thinks with reason, that this cross (4 bis) was placed on the gable of the western facade; we believe that it belongs to the end of the 12 th century. The church of Montreale near Avallon, which dates from that epoch, still possesses on its four gables beautiful crosses of varied forms, whose graceful outlines terminate perfectly on the exterior the simple structure of that church. We give (5) one of those crosses cut in great slabs of hard limestone from Contarnoux. That is only

5.3 ins. thick at its base as indicated by the side elevation A.; the foot is sunk into the stone crowning the gable, and the centre of the cross is perforated.

During the 13 th century statues were in honor, and whenever they could, the architects terminated the gables by statues rather than by crosses; yet the gables of the transepts of S. Urbain of Troyes have still retained in place the remains of the crosses of the end of the 13 th century, very rich and of great dimensions. We reproduce (6) one of them, that is cut n in hard stone from Tonnerre. This cross is composed of six p pieces: a foot A, a ring B in two courses, a vertical C, a cross-peace D, and the upper arm E. At G is traced the plan of the cross at the level A, and at K is seen in section how the double ring encloses the two ends A and C of the foot of the vertical. Besides this double ring, whose two parts are made solid by six little copper cramps set in lead, there exists at I a copper pin; another copper dowell maintains the u upper arm, the cross-piece and the stem. All the joints and dowels are cast with lead with great care. Two heads of bishops ornament the centre of the cross, and these two heads with the corbels and supports contribute in giving a bearing for the cross-piece on the stem. As always in the architecture of that epoch, the decoration is there the result of the construction, and this decoration is not at all bad. We have said t that many timer, and we repeat it again, for it is necessary to insist on it; if the truth appears or is spoken only once, no person has seen or understood it; it is necessary to repeat it, when persons treat it as trifiling, then they have understood it.

During the 15 th century, gables are frequently terminated by crosses, but these lose their monumental character suited to these ornaments placed at a great height, and they are covered with details like the crosses of cemeteries or of roads, made to be seen near at hand.

But the gables of country churches, where sculpture could not be lavished, were terminated by stone crosses as in the preceding centuries. These crosses are simple, usually supported by a short cylindrical column, terminated by a ring forming a capital. Such is the little cross of the church of S. Thomas. (7). The coping moulding covering the gable proj-

projects to form a foot and to give breadth at the base.

It is known how the order of Citeaux has opposed, in the c churches that it built during the 12 th and the beginning of the 13 th centuries, to the sculptures lavished in the edifices of the order of Cluny. (Art. Architecture Monastique). The tympanums of the portals of the churches of the order founded by S. Bernard ane usually decorated only by a simple c cross in relief. We give (8) that still seen above the lintel of the doorway of the church of Pontigny, and which dates from the end of the 12 th century; its four arms are of equal length.

Also frequently in the interiors of churches on the piers, and even on the exterior, on the faces of the buttresses, were sculptured in the Romanesque period crosses with equal arms. Most of these crosses (at least those in the interior) were crosses of consecration. One of these crosses is to be seen t today on a buttress of the church of S. Palais. Although that dates from the 13 th century, the cross (9) certainly belonged to an edifice of the 11 th or 12 th centurier, and it has all the characteristics of a cross of consecration. There still exists on the facade of the church of S. Giers-la-Lande three engraved and pointed crosses, one on the keystone of the doorway, and the two others on the sides of the jambs. Here is one of these crosses; (10); they are only incised lines filled w with black color.[1]

Note 1.p.426. This data was furnished to us by M. Alaux, or architect at Bordeaux.

On the piers of the walls of the side aisles of churches of the 12 th, 13 th, 14 th and 15 th centuries, we have frequently discovered under the whitewash painted consecration crosses; here are several examples (11). The cross A seems to us t to belong to the 13 th century; B to the 14 th and C to the 15 th centuries. In our engraving black indicates black; dark gray is reddish-brown; light gray is yellow ochre, and white is white; these are the colors generally employed.

It sometimes occurs that the consecration crosses of churches during the 13 th and 14 th centuries were borne by painted or carved figures of the apostles. In 1854 was discovered in the church of S. Hubert of Narville under the whitewash mural paintings, among which are seen apostles bearing the crosses

of consecration. These figures are painted on the walls of t the side aisles and choir; they are described and engraved in Vol. 20 of the Statistique monumentale, published by M. de Caumont. Everyone knows the statues of the apostles at the S. Chapelle of the palace at Paris, which bear the consecration crosses. (Art. Apotre). On the piers forming the heads of the chapels of the cathedral of Troyes are noted square stone slabs overlaid, the angle down, on which are painted figures of apostles also bearing crosses of consecration.

During the middle ages iron crosses were always placed at t the top of wooden towers covered with slates or lead, and even sometimes at the apexes of the stone pyramids, that terminated the towers of religious edifices. The iron crosses were surmounted by a cock or a simple vane. There exists a small number of those old metal crosses, often damaged by lightning or destroyed by time and the hand of man. Most were of rich design, gilded and of large dimensions. Their base consists of a ball or of a ring frequently representing a dragon, a s symbol of the demon, or again the crown of leaves. Relics were usually deposited in the ball, that served as their base, or in the cock surmounting them. (Art. Coq). The system of c connection of these terminal crosses merits being studied with care by constructors; for these iron articles placed at a great height, heavier at top that at base, were exposed to n hurricanes and did not fail to break soon, to be deformed or wear their fastenings. If these crosses were fixed in stone, to avoid the vibration produced in the fastenings by the force of the wind on the body of the cross, it was necessary to proceed with extraordinary precautions. The principal stem w was composed of three or five bars; one central and two or four braces. Assume the apex of a stone spire composed of courses (12). The hollow portion of the pyramid stops at B. The main bar of square iron C D passes through the solid courses of the top of the spire forming a terminal, and its lower end is fastened by a key at D. Two or four braces E, held by two bands I K, bent according to the profile of the crowning, abut against a stop on the rod at G; so that if the wind pushes the central bar to one side, its force is neutralized by the resistance opposed by the braces, the resistance resolved into a pressure at F or La As for the two branches of the cross,

they are connected by halving, as practised in modern ironwork, and which is very bad, but by means of a reinforced socket wi with a hole for a bolt or great rivet, as indicated in Fig.13.

These minute details are not to be disdained; too frequently in our days their execution is left to a contractor, who in his turn refers them to a foreman, who trusts to the intelligence of a workman. An accident happens, one takes it to the architect, who transfers the fault to the contractor, who throws the blame on the foreman, that accuses the workman, who left the yard six months previously!

If the iron cross is placed on the top of the frame of a w wooden spire, its stem has under the covering two, three or four branches, according to the degree of strength to be given to the cross and the resistance that must be opposed to the wind. The branches of the fork are nailed to the wood, and further have bands fixed hot, to strongly hold the ironwork. If the cross is of very great dimensions (a cross of a spire like that of Amiens or of Notre Dame of Paris cannot have less than 26.3 ft. in height), it is composed of a considerable number of pieces, that we can separate thus, (14); 1, the stem A (see Horizontal section P) with its reinforcement for receiving the crossbar, 2, the crossbar B; 3, the four square bars C, more or less decorated and maintained by means of rivets indicated in the detail C (these square bars are i inteuded to prevent the crossbar from straining the joint and central bolt, and as a result to incline to one side or the other); 4, D the four branches with indents forming forked b branches nailed and banded on the ends of the wooden principals; 5, E the three bands made as shown by the sketch E, with little keys, so as to be strongly fixed; 6, F the cap, and G the clips, 6, H the bolt holding the crossbar against the stem in its recess, in all 17 pieces of iron. At V is sketched the end of the stem anf the cross, with the rod on which turns the weathercock, at 1 is forged an end of the crossbar. T The stem is independent and is only maintained in a vertical line by the four branches D fixed at the top of the principals. Such ironwork with a height of 13.1 or 16.4 ft. may retain t the elasticity necessary to not be broken by a rurricane, for the four braces taking the place of forks always act inversely; if one is stressed by the effect of the wind by the means

of the stop I, the opposite reinforcement acts as a tie by the resistance opposed by the indents K. It is unnecessary to say that the timbers are covered by lead up to the cap F. If the cross attains greater dimensions (23.0 or 26.3 ft.), it is prudent to have double braces with double stops and doubled indents, to make the stem of two bars bolted and riveted together, placing the crossbar between them. Ironwork so combined could be enriched by means of scrolls and ornaments of hammered iron attached and riveted. The braces with their joints could be covered by leaves of plate cut and modeled, accompanied by branches of round iron, recurved and bearing at their ends flowers of cut plates.

Fig. 15 gives the idea of this sort of applied ornamenteaton.

On spires of ordinary dimensions, iron crosses do not need to be combined and fixed with this luxury of precautions. Some are so forged that the branches and vertical stem form only a single piece with its parts welded together. The little iron cross of the tower of Puybarban near Reole is so fabricated. Although that cross has been placed on a spire of the 17 th century, it is of the end of the 13 th or 14 th centuries.[1] We present (16) the general drawing and the details. The fleurs-de-lis are doubled, i.e., are placed in two directions as indicated by the perspective sketch (16 bis) of one end of t the cross. A little vane rotating on the upper arm here replaces the traditional cock. The cusps that ornament the central square are simple riveted to the sides of the square. In spite of its extreme simplicity, this cross does not fail to be of graceful form; and if we are accused of indulgence favoring the arts of the middle ages, we should not prefer to it the cast iron crosses, that are now placed at the tops of spires. That opinion is very probably not shared, since most o old iron crosses, that have resisted the storms of the end of the last (18 th) century, have been taken down and sold to t the dealer in old iron in exchange for those models in cast iron, that one finds on the quays of Paris in company with stoves and garden seats. In Brittany and Normandy are still found some spire crosses of wrought iron, that date from the 15 th and 16 th centuries. Here (17) are some of the motives most commonly reproduced.

Note 1.p.431. M. Aloux, architect, took the trouble to draw this wrought iron cross.

CROIX DE CHEMINS ET DE LA CIMITIERE.

Crosses of Roads and of cemeteries.

At what epoch did men commence to erect crosses at cross r roads, at the entrances of cities and villages and in Cemeteries? I cannot say. One can only state that this custom was very widely distributed from the first times of the middle a ages. Among the monuments still standing, we know none that o precede the end of the 12 th or beginning of the 13 th centuries. It is to be believed that many of these crosses earlier than the 13 th centwry, of stone or wood, were covered by a hood; for in a manuscript of that epoch is read this passage: (old French text).[1] thus there have existed coverings over the roadside crosses, since the priest Jehan does not wish them placed on those erected in his territory, so that over the cross there is nothing blessed or consecrated. This idea indeed seems to prevail during the 13 th century, for one finds no old traces of hoods or of shelters covering the roadside crosses at that epoch in the north of France.

Note 1.p.433. Additions aux Oeuvres de Rutebeuf; Lettre de Prestres-Jehans, published by Jubinal. Vol. II. p.464. There exists a beautiful cross of sandstone at the top of Rue S. Bertin at S. Omer; That cross was destroyed a few years since, and is said to have dated back to the 10 th century. (See the Abber de S. Bertin, by M. Henri de Laplane, part I, p. 118. S. Omer, 1854.

Further, there is reason to believe, that crosses were not protected by hoods except when they bore the Christ, or when they were made of perishable materials, or painted and gilded; for one still sees Romanesque crosses of cemeteries and cross roads, that certainly were not made to be placed under a shelter. The stone cross here given (18), and which is still placed in the cemetery of Baret near Barbezieux, is in too rude work for anyone ever to have had the idea of covering it. This cross appears to belong to the 11 th century.

The crosses at cross roads ane usually placed on a base forming a sort of little altar with some steps before it. the crosses of cemeteries rise on steps more or less large, a table is placed before or around the column bearing the cross. In t the cemetery of Mezy still exists a cross of this kind, whose column passes through the altar table supported by four figures of the evangelists backed by little columns (19). We give

at A a section through the axis of the column. The top of this stone cross no longer exists, the column is broken off at the level B. To complete it we give (19 bis) the fragments of a beautiful cross of the same epoch (about 1230), that are deposited under the porch of the church of Rougemont. On one side of this cross is attached the Christ, on the other in the sculptured medallion at the centre is carved a hand of blessing. The section of the stem is sketched at A, that of the arm at B. About the middle of the 13 th century, crosses of roadsides or of cemeteries frequently presented the Christ attached to the front, and on the back the Holy Virgin carrying the Child; or again the statue of the Virgin is placed against the column beneath the cross and the crucifix is double. One sees at Foucneres near Troyes the remains of a charming cross of this kind, which was formerly placed at the head of the bridge. It rested on a pedestal and steps. To the column is attached a statue of the Holy Virgin 4.6 ft. high, it stands on a group of three little columns connected to the main column. From the capital that terminates the column rises the half length of an angel, so arranged that its wings and body form a canopy over the head of the statue (20). Formerly a stone crucifix about 5.9 ft. high surmounted the capital; the figure of Christ was sculptured on each face; one turned to the east and t the other to the west, the ends of the arms of the cross were terminated by bunches of leaves. That crucifix is now destroyed, and the little monument exists only up to the upper capital. The Virgin looks toward the ground and smiles; her head is covered by a vail and by a fleury crown; Every year, during the harvest and vintage, the peasants attach bunches of w wheat and grapes to the feet of the mother of the Saviour.[1] From the base of the crucifix the column is composed of three stones, whose beds are marked at L. The horizontal section b below the Virgin gives the plan A. It is understood that the statue is cut in the same block of stone as the column against which it is placed.

Note 1.p.434. We owe this drawing to M. Millet, diocesan o architect of Troyes.

Most of these roadside crosses were erected to preserve the memory of a memorable fact or as a mark of separation. On the route followed by Philip the Bold from Paris to S. Denis, be

bearing on his shoulders the remains of the king S. Louis, we were erected at each station of the procession stone crosses, that passed for very beautiful works. Remains of them were s still seen in 1792, they were very beautiful, of lias stone, and placed on high steps.

During the 14 th and 1 th centuries, to the road crosses was given great richness, the figures accompanying Christ were multiplied, while always retaining the primitive arrangements. In our provincial museums are still seen a quantity of remains of road crosses, they were multiplied infinitely, for the old ones were removed and new ones were erected daily; but it is rare today to find any that were not broken during the religious wars or at the end of the last (18 th) century. Yet there exist some in the localities forgotten by the iconoclasts; they are of rude work, for the most beautiful were found near the great centres, and these were first to be destroyed, yet all these monuments op barbarous execution are c copies or reminiscences of works, that passed as being remarkable, and from that point of view should be studied with care. Among those rude imitations, we can cite the cross of Beloech (21). The cross is carved and decorated by cross-flowers, and bears on one side Christ having the Virgin on his right and S. John at his left. At the bottom of the cross two little f figures receive the blood of the Saviour in a chalice. Two he heads above the arms of Christ personify the sun and moon. T The back bears at the centre the Holy Virgin with the Child. Two angels hold the crown of the mother of God, on her right is S. John Baptist; at her left is S. James the Pilgrim. The capital bears four very stumpy figures with halos, among which is distinguished S. Andrew. Two escutcheons are seen between the figures. This monument dates from the end of the 14 th century; it was entirely painted and covered by a hood, for it appears that at the end of the 14 th century men returned to that custom of covering roadside crosses.

There is still seen on the place of Royat opposite the church a pretty cross of lava of the 15 th century. We give a view of it (22). The figures of the 12 apostles are sculptured on the principal shaft between four small buttresses. An inscription giving the year 1481 is carved at the foot of the cross beside the Virgin. On the faces of the base in little niches

are noted 8 little figures, probably of prophets.

The roadside crosses, of cross roads and of cemeteries were not always cut in stone, marble or granite, they were constructed of wood, inserted in a stone base. It is unnecessary to state that these were destroyed long since; their existence can only be proved by the presence of these stone bases pierced by a square hole, that one still finds in the country and in cemeteries. There also existed crosses of bronze and of wrought iron. Those metal articles, particularly those of bronze, were melted at the end of the last (18 th) century, and we no longer possess a single example.in France. The form of these bronze crosses differed from those given to crosses of stone or of wood; they were more slender , more detailed and richer, and they were frequently divided into several branches to support the figures. In the Album of Villard of Honnecourt is seen one of these crosses, whose upper part could only have been executed in cast copper.[1] It consists of a column, perhaps of stone, placed on steps. From the column rises the cross with Christ and two crosses fully detached, bearing the Virgin and S. John. If we take into account the conventional manner employed by Villard in his drawings, and we restore the sketch and proportions, we obtain Fig. 28, which gives a beautiful example of a stone cross from the ground to the level A, and of metal from A to the top, this cross belongs to the time when Villard lived, i.e., to the first half of the 13 th century. Save some rare exceptions, Villard was not an archaeologist and only filled his Album with drawings made from contemporary monuments. "In the 15 th century" says Courtalon, "there existed at the church of S. Remy of Troyes a numerous confraternity of the cross at the altar of that name. With the offerings made there, the members could erect in March of 1495, near the church of S. John in the Grande Rue, a very beautiful monument in honor of the cross, that was called the Belle-Croix.(Beautiful cross).[2]

Note 1.p.441. See Album de Villard de Honnecourt, architect of the 13 th century. p. 85. Pl. 14. Imp. Lib. 1858.

Note 2.p.441. The place occupied by that cross at Troyes still bears the name of Belle-Croix.

The description of this cross, that is found entire in the Voyage archaeologique dans le departement de l'Aube,[3] gives t

the idea of a monument of great emportance. This cross was entirely of bronze, except the pedastal, and was decorated by numerous figures, among which were distinguished Satan and S Simon the magician, that the people of Troyes called Simon Maquet. . At the feet of the Christ was seen the Magdalen embracing the foot and the stem of the cross, at each side were S. John and the Virgin; below were S. Louis, S. Loup, S. Louis and prophets, among whom was seen Mahomet. A memoir on this monument was drawn up in 1530 and reported by Grosley, which informs us that it was originally surmounted by a canopy or dome of masonry, borne by very high columns, "the whole very triumphan and full of paintings of gold and azure, furnished with images and other beautiful and appropriate works. That this cross replaced one of hard stone decorated by images, that fell into ruin and decadence, was removed and transported to the cemetery of Hotel-Dieu-S. Esprit, and was then collected and erected close to the tomb of the noble man, Nicolas Boutiflart, during life a citizen of Troyes."On Wednesday, Dec. 5, 1584, a hurricane overthrew the dome on the cross, w which was broken, though a great bar of iron traversed it from top to bottom. "The fall of the beautiful cross," adds M. Arnaud,"facilitated the examination of the relics that it enclosed; there was found in the head of the image of the Virgin, which was behind the crucifix, a small closed bronze box fastened by an iron wire." The following year, In 1585, the beautiful cross of Troyes was restored, but without the dome that covered it. This monument was melted in 1793; it furnished 942 lbs of bronze, its height was 36 ft.

Note 3.p.441. A curious work published by M. F. Arnoud, painter. Troyes. 1831.

We give (24) from an old drawing and stained glas of 1621, representing"the entry of king Henry the Great into his city of Troyes in 1595,"the entire monument without the dome that covered it, of the form of which we have no graphical data.

In Brittany are still seen a great number of stone crosses from the 15 th and 16 th centuries. (See Voyage pittoresque d dans l'ancienne France, by M. Nodier and Taylor.

CROSSE. Art. Crochet.

CROSSETTE. Horizontal end of a voussoir.

Stonecutters give this name to the ends of the voussoirs of an arch, that return horizontally to form a wall. During the middle ages these were not employed in the jointing of arches; they always had an extrados. (Arts. Appareil, Construction).

CROUPE. Hip Roof.

Signifies that a roof does not rest against a masonry gable. Circular or polygonal apses of churches are terminated by hip roofs. (Art. Charpente). In civil architecture, architects u until the 16 th century very rarely employed hip roofs; the buildings are covered by gable roofs closed by gables at their ends. This was an antique tradition that the middle ages h had scrupulously retained, and it was very wise. The artists of the Renaissance, and particularly those of the 16 th century; who pretended to return to the principles of antiquity commenced to place on edifices roofs terminated by hip roofs, and in our days as one on the facade of the Pantheon, for example,,men have gone so far as to place hip roofs on pediments that are gables. It is difficult to carry farther the forgetting of the principles of the architecture of the Greeks and Romans. But in the history of our art, one finds during three centuries many other singular things.

CRUCIFIX. Crucifix.

Christ on the cross. In cathedral, abbey or parish churches, it was customary to place great crucifixes of wood or metal suspended over rood galleries or transverse beams, that indicated the entrance to the choir. There exists in the museum of Cluny a crucifix of the 12 th century, as large as nature, w which must have been made to be set above a beam. This figure is of chestnut wood; the nude parts are covered by painted p parchment; the draperies, head and hands alone are without a covering. Du Breuil [1] relates that at the entrance of the choir of the cathedral of Paris, at the top of the gates of the rood screen rose "a great crucifix, that with its cross was in but one piece," and he adds,"that its foot was made in an arch of another single piece, which are two masterpieces of cutting and sculpture."

Note 1.p.444. Theatre des antiquities de Paris, p. 13. 1622.

"In the primitive times," says M. Didron, [1] "was seen the c

cross, but without the crucified deity. About the 6 th century is a mention of a crucifix executed at Narbonne; but this is a strange fact and mentioned for its novelty. In the 10 th century some crucifixes appear here and there; but the crucified One appears there with a mild and benevolent countenance; he is further clothed in a long robe with sleeves, that only permits the nude to be seen at the extremities of the arms a and legs.[2] In the 11 th and 12 th centuries the robe is shorter, the sleeves disappear, and already the chest is sometimes uncovered, because the robe is only a sort of tunic.[3] In the 13 th century the tunic is as short as possible; in the 14 th it is only a piece of woolen or even of linen, wound around the loins, and thus until our days, Jesus on the cross has constantly been represented. At the same time that gloom is cast on the figure of the crucified, and that are impressed the p physical sufferings of his divine body, at the same time it is despoiled of the robe and the little vestment that protected it." Indeed the crucifix in the museum of Cluny is covered by a short skirt with little folds, his head does not indicate physical suffering, but rather benevolence; his eyes are open, his hair is not in disorder, and it does not appear that the crown of thorns has been placed on his head. The primitive crucifixes, such as those of S. Sernin and Amiens, have t the head covered by a royal crown. In the 12 th century Jesus on the cross usually has the head bare, and it is only from t the 13 th century that is seen the crown of thorns enclosing his head, bowed toward the earth. Yet the tendency toward realism already makes itself felt at the end of the 12 th century. There exists in the sacristy if the cathedral of Bordeaux a crucifix of ivory of great value as a work of art; it belongs to the second half of the 12 th century. One sees that th the artist has sought the imitation of nature, and the tortured deity is a suffering man. The head (1) however retains a calmness and a grendeur of expression, that merits the attention of artists. Only three nails fasten the members of Christ, while before that epoch the nails are four in number. The crucifix placed on a rood screen is ordinarily accompanied by t the Virgin and S. John. The Virgin is placed at the right of the Saviour, S. John on his left. Sometimes an angel at the foor of the cross receives the blood of Christ in a chalice.

In paintings and stained glass, on the reredoses of altars, o one frequently sees at the right of Christ the Church, that receives the divine blood in a chalice, on his left being the Synagogue, that turns away and whose eyes are covered by a v veil. (Arts. Eglise, Synagogue). Usually Christ on the cross has a cruciform halo.

Note 1. p.448. Iconographie chretienne, histoire de Dieu. . p. 244. Paris. 1843.

Note 2.p.443. The crucifix of S. Sernin of Toulouse, and t that of Amiens.

Note 3.p.445. Rather a short petticoat.

Yet this sign of divinity is omitted in many paintings and reliefs of the 13 th and 14 th centuries. In paintings, stained glass and reliefs, the artists have often represented above the arms of the cross the sun and moon under the form of busts of angels, weeping and holding two stars in the folds of their mantles, or again in the form of gilded disks, one radiating and the other indented. About the end of the 13 th century, Christ on the cross as twisted and weakened, and the arms no longer form right angles with the body. The head of the Saviour is impressed by the expression of physical suffering carried sometimes even to exaggeration, as may be recognized by examining the stained glass of paintings of that epoch. (2).[1] This tendency to realism is still more sensible during the 14 th century, and the artists came in the 15 th century to give to the crucifix all the appearance of a human nature subjected to the most painful torment; this was to replace in the minds of the faithful the sentiment of the triumph of the divinity on the cross by the feeling of pity.

Note 1.p.448. From the old chapter hall of the cathedral of Puy-en-Velay.(Fresco painting of the end of the 13 th century).

CRYPTE. Crypt.

The etymology of this word (cryptein, to conceal) sufficiently indicates its signification. The first crypts or consecrated grottos were cut in the rock or built of masonry underground, to conceal from the eyes of the proface the tombs of the martyrs. later and over those caverns venerated by the first Christians were erected chapels and vast churches; then crypts were established beneath edifices intended for worship, to con-

contain there the sacred bodies collected by the piety of the faithful. Many of our old churches possess crypts that date in a very remote epoch; some are only rectangular rooms covered by tunnel or cross vaults, after the antique method, sometimes only ornamented by fragments of columns and capitals r rudely imitated from Roman architecture, others are actual s subterranean churches with side aisles, apses and niches. Crypts are generally entered by stairs that start at both sides of the sanctuary, or even on the axis of the choir.

The churches of France and of the banks of the Rhine present great variety in the arrangement and form of their crypts; several are constructed with a certain luxury, decorated by paintings, by marble columns and ornamented capitals, and are sufficiently large to contain a great number of the faithful; they most frequently possess two stairs, to permit the numerous pilgrims, who come to implore the assistance of the saints whose remains are deposited beneath their vaults, to descend in procession by one stairs and ascend by the other. Thus are avoided disorder and confusion.

With rare exceptions, crypts receive light by narrow windows opened on the exterior of the church or the side aisles of the sanctuary. This last arrangement seems to have been adopted when the crypts were excavated under the choirs of Romanesque churches surrounded by a side aisle. Thus the openings th that admit air and light into the crypt open in the wall of the consecrated place. Then the choirs were elevated above the pavement around them, which adds to the solemnity of the religious ceremonies, and this permitted those present to see from the side aisle what occurred in the crypt. Most Rhenish churches still retain that arrangement, that we see adopted in a little church, several parts of which seem to date from the 6 th century; we speak of the church of S. Martin-au-Val of Chartres. "Originally one entered the crypt," says M. Paul Durand, in the faithful description that he has given of that edifice,[1] "by two little doorways placed at the right and left of its western part. These doors still exist. It is probable that formerly the spectator, placed in the great nave, could see the interior of the crypt through a middle or two lateral openings made in its western front, as may still be seen in several churches of the Centre and West of France." Between

the raised floor of the sanctuary and that of the side aisle is a sufficient difference, that windows could be opened in the substructure of the arcades of the choir, so as to light the crypt and permit the interior of the crypt to be seen, whose vaults rest on two rows of four little columns each. Although the church may have been mutilated and partly rebuilt on several occasions, still the bases of the little columns of the crypt and some primitive capitals are work, that appears to belong to a very remote date, still near to the arts of the late empire, and presenting all the characteristics of the sculpture of the celbrated crypt of La Ferte-sous-Jouarre.[2]

Note 1.p.448. Rapport sur l'eglise et la crypte de S. Martin-au-Val at Chartres, by M. Paul Durand. Chartres. 1858.

Note 2.p.448. See Archives des monuments historiques, pub. under the auspices of S. E. minister of State. Gide Edition.

Romanesque crypts rarely have a height over 9.8 to 13.1 ft. from floor to vault; it was then necessary for these vaults to be borne on a quincunx of columns, if the crypt occupied a very extended area. However the crypts being excavated under an apse or a sanctuary surrounded by columns, the wall that enclosed them at the east was generally semicircular. let us take as an example one of the oldest remaining crypts, that of S. Avit of Orleans.[1] S. Avit died between 527 and 529; his body was transported to Orleans and buried not far from the walls. "Childebert I, passing through Orleans to go to fight the Visigoths, desired to see the relics of the saint; he made a vow to build a church at that place where they were deposited, if he obtained the victory; he returned triumphant and fulfilled his engagement.[2]" The church was afterwards sacked several times by the Normans, during the siege in 1429 and in 1562; it was torn down in 1710. Even a trace of it was lost, when in 1853 excavations made to extend the buildings of the seminary brought to light the crypt of S. Avit, which appears to us to belong to the structure of Childebert.

Note 2.p.449. See Rapport sur la crypte decouverte dans le jardin du grand seminaire d'Orleans, by M. Buzonniere.-- Bull. du com. de la langue, de l'histoire et des arts de la France. No. 5. p. 399. 1853.

Note 1.p.449. This crypt is now comprised in the buildings of the great seminary of Orleans.

We give (1) the plan of this monument. It will be observed that the entrance A is found below the semicircle, whose vaults are borne by 4 piers of octagonal section, at B is a rear hall (martyrium) separated from the apse by a masonry wall wi with openings. The little altar must have been placed in C a and the body of the saint in D. We find analogous arrangements adopted in most of the primitive crypts; indeed the relics w were deposited beneath the main altar of the sanctuary, placed before the apse occupied by the clerics. Fig. 2. gives the t transverse section of the crnpt on the line F G looking toward the open wall; and Fig. 3 is the longitudinal section on the line H I. The last section shows at A the tomb of the s sacred body, at B is the principal upper altar placed in the sanctuary above the body of the martyr, at C are the seats of the clerics (chorus), and at D is the altar of the crypt. The construction of the crypt of S. Avit was made of rubble rudely dressed, separated by very thick mortar joints. The grotto designed to receive the sacred body is sometimes merely a recess, as at S. Germain of Auxerre, in the crypt of the cathedral of Chartres, and in the church of Vezelay; on the contrary the crypt is sometimes an actual nave enclosed by a side aisle. The last monument is well marked in the crypt of the cathedral of Auxerre, that we suppose was built in the 9 th to 10 th centuries. Here (4) is the plan of this crypt, today enclosed in structures of the 13 th century. The martyrium A is a long hall with vaults resting on a quincunx of piers; the sacred body was placed at B, the little twin opening at the back recalls the opened wall that we found in the crypt of S. Avit of Orleans. An ambulatory C surrounds the martyrium; a single stairway remains now at D, but there is every reason to believe that another was found at F. The altar was placed at the back of the niche G. Thus the faithful descended by o one of the stairs, could see the tomb of the saint through t the openings arranged in the wall of the martyrium, make their prayers before the altar,and ascend by the other stairs. The crypt of the cathedral of Chartres had a very narrow stairs but an ambulatory with chapels of great extent.[1] The crypt of the abbey church of S. Denis presented the same arrangements before the rebuilding undertaken by Suger; in rebuilding the semicircle, the illustrious abbot retained them and added vast

chapels to the ambulatory surrounding the martyrium, to which he left its primitive form,[2] probably not desiring to touch this consecrated place. Yet it was Suger that removed the relics of S. Denis and of his two companions from the crypt, w where they had been deposited, to place them beneath the altaar of the martyrs, at the back of the sanctuary.[3] (Art. Autel).

Note 1.p.452. See monog. de la cath. de Chartres, by M Lassus, pub. by ministry of public instruction and worship. (Incomplete); and Description de la cathedrale de Chartres, by abbe Bulteau.

Note 2.p.452. The martyrium of S. Denis dates from the 9 th or 10 th century.

Note 3. p. 452. See Art. Chasse, Dict. du Mobilier Franc.

One of the largest crypts that has been erected is certainly that of the abbey of S. Benigne of Dijon. This crypt existed from the 6 th century beneath the sanctuary of the church built by Gregory, bishop of Langres. In 1001 William, abbot o of S. Benigne, undertook to rebuild the church and crypts. D. Planchet [4] prefers that William only repaired the work of bishop Gregory, and that he only built entirely the rotunda seen behind the apse. As for the church, we cannot know whether he rebuilt or repaired it, because it was entirely rebuilt at the end of the 13 th century; but some recent discoveries [5] have laid bare the remains of the martyrium containing the tomb of the saint and the cellars of the rotunda belonging to it; now these structures are identical and possess all the characterics of the barbaric architecture of the beginning of the 11 th century. It is then necessary to see there the monument of t that epoch; yet it is certain that abbot William retained the masses belonging to the preceding structures, one recognizes the junctions, and finds fragments of an older structure again used as rubble.

Note 4.p.452. Hist. de Bourgogne. Vol. 1.

Note 5.p.452. Excavations made in Nov., 18.8, under the direction of M. Suisse, architect, have uncovered the remains of the crypt of S. Benigne and the lower story of the rotunda. These precious remains are to be consolidated and will be preserved.

The subterranean plan of that edifice, unique in France (5), shows clearly that the primitive crypts extended beyond the

parts A, under the transepts of the lod church. In these two galleries most probably ended the stairs of the crypt of bishop Gregory. Perhaps from the time of William, these old stairs had already been suppressed or judged insufficient, since two others had been constructed in the two round towers B, that flank the rotunda. The tomb of the martyr was at C, covered by a shrine and placed below the pavement of the crypt.[1] At D is found the chapel of S. John Baptist, erected in the 6 th century, if one believes D. Planchet.[2] The entire crypt, rotunda and chapel, are vaulted with rubble, except the middle part G, which remains open. This arrangement known, one understands now the processions of pilgrams must pass around the tomb of the saint, around the rotunda, ascend either by the stairs to the two round towers, or by one of the stairs originally opened at A. The circular crypt, not vaulted at the centre, allowed two stories terminated by a dome,of galleries to be seen, which must have produced a very beautiful effect. Before the rebuilding of the choir in the 13 th century, whose foundations are seen at H I I, it is to be believed that the extent of the subterranean story was greater still, and extended under the Romanesque choir and the transepts. Then one can regard the crypt of S. Benigne of Dijon as the largest of known crypts. This very remarkable monument was sold for the value of the materials at the end of the last (18 th) century by t the commune of Dijon. (Art. Saint-Sepulchee). The contractors judged that the stones of the crypt were not worth the trouble to be taken to remove them, and this crypt has remained to us nearly entire. Today the people of Dijon accuse their fathers of vandalism in regard to the venerable remains of the ruins.

Note 1.p.454. The remains of this tomb are still visible.

Note 2.p.454. The substructure of this chapel not being uncovered, we cannot assign a precise date to its construction.

This arrangement of crypts, whose ambulatories are found o outside the place reserved for the body was not the only one. In many crypts of small dimensions, the sacred body occupied a sort of niche or little apse built or excavated at the eastern end; then the faithful on descending the stairs found t themselves before the sacred body as before an altar placed at the back of a chapel. The crypt of S. Seurin of Bordeaux, which dates from the 11 th century is constructed on that pr-

principle. Here (6) is its plan and (7) a perspective view of the interior, the tomb of the saint is placed in the middle of a sort of grotto preceded by a hall with three aisles, the central nave has a tunnel vault, as well as the side aisles.

There exists at Vico in the district of Gannat a little and very curious crypt, in which the place of the reliquary is perfectly indicated behind a massive altar. A single stairway d descends to that crypt, whose plan is here (8). The reliquary is at A and partly enclosed in the wall. The view (9) of the rear of the crypt needs no description.

Sometimes, but more rarely, crypts present in plan the arrangement of the upper story. Such is the beautiful crypt of S. Eutrope of Saintes, one of the largest existing in France. This crypt also presents a remarkable peculiarity, that it is abundantly lighted, and that its capitals are richly sculptured. We regard this structure as in part belonging to the last years of the 11 th century or the beginning of the 12 th. It is a nave (broad for a crypt) 17.7 ft. wide, terminated by a semicircle with side aisle around it and three radiating chapels. Here is its plan (10). At A is the tomb of the saint, c composed of a slab placed on two steps.[1] The construction of the vaults of the crypt of S. Seurin of Saintes merits being examined with care; the vaults of the middle aisle belong to the 12 th century; they consist of transverse arches giving a half cylinder in section, between which are turned cross vaults of rubble and without groins, at the apse there are arches of rectangular section, that unite there in an enormous boss. Our perspective (11) gives the appearance of the interior of this crypt. The walls of the side aisles were repaired at the end of the 12 th and in the 13 th centuries, as well as the vaults of the two side chapels. The apsidal chapel was rebuilt, but the original arrangement is easily seized. Like the upper church the crypt is preceded by a vast narthex, whose walls alone belong to the construction of the end of t the 11 th century.

Note 1.p.457. M. Letronne thinks that the funerary slab dates from the 4 th or 5 th centuries. An altar has unfortunately been placed before that tomb, and it destroys the grand effect of the crypt. On one of the slopes of this funerary slab is r read in Roman capitals only the incised name- Eutropius.

It seems to us superfluous to multiply examples of these s subterranean structures, that nearly everywhere present the same charcater. We have sought to show our readers the most remarkable varieties of French crypts, often these are only very simple cellars without side aisles and deprived of all ornament, or structures whose irregular shape was caused by ancient exacvations, and were held to be preserved by a feeling of religious respect.

About the eud of the 12 th centurw, most of those sacred b bodies, until then contained in the cryots, were placed in metal shrines and deposited under or behind the altars of the upper churches, thus one sees no crypts in churches entirely built since that epoch. The cathedral of Bourges forms a single exception; but the sloping ground on which was erected that edifice, much more than any religious idea, caused the adoption of the construction under the side aisles of the apse, of a subterranean church, that indeed is only a ground storw. At Chartres the architects of the 13 th century retained the old crypt of the 11 th century, because that crypt was held in s singular veneration among the faithful, and that the solidity of the construction permitted the placing of the new structure on that old masonry. The programme according to which the French cathedrals were erected at the end of the 12 th century did not comprese crypts, since those vast edifices then had a character both civil and religious. (Art. Cathedrale). Besides, one will observe that most of the old crypts of the parish or monastic churches were so arranged, that from the nave were seen the entrances to the crypt, the choirs must then be elevated above the pavement of the transepts by several s steps, as for example in the abbey church of S. Denis. That arrangement suited a monastic church of which only a part was reserved for the public, but could not be accepted in our great French cathedrals, where it was especially required to offer to the multitude of the clergy a level area from one end to the other of the edifice,[1] except at the entrance of the choir, which with its side aisles was raised two or three steps.

Note 1.p. 459. For example at the cathedral of Paris, before the enclosure was established in the 14 th century, the sanctuahy was on a level with the side aisles of the choir; the altar alone was raised by several steps.

On the contrary on the banks of the Rhine and in the provinces of the East, the cathedrals possessed from the 11 th c century and retained later their crypts half buried in the ground, so as to raise by several feet the pavements of the sanctuaries. Those cathedrals having two apses during the Romanesque period, one at the east and the other at the west, these two apses often each had its crypt lighted from the north and south side aisles, and by windows pierced in the semicircle without side aisles. At the cathedral of Besancon, before the mutilations that for a hundred years have successively modified the plan of that beautiful edifice, there were two raised sanctuaries and two crypts, the same arrangement at Verdun. At Strasburg one of the two crypts is retained beneath the choir much elevated above the nave. At Bamberg are still seen two sanctuaries at east and west with their enclosures and the two crypts. One of the most beautiful and oldest crypts on the banks of the Rhine is certainly the crypt of t the cathedral of Spires, which according to the usual custom is half buried in the ground and receives light from the exterior. In England the crypt of the cathedral of Canterbury is far largest and the most interesting, having been successively enlarged as the edifice was extended.

All the old Romanesque crypts present traces of paintings, the very curious ones in Auvergne were entirely covered by l legendary subjects often carefully executed. Under the choir of S. Benoit-sur-Loire exists a crypt allowing still to be s seen fragments of painting, that belong to the 10 th or 11 th centuries. In a great number of crypts exist wells; frequently the water was regarded as miraculous.

We should not close this Article without mentioning a singular fact. Hugues of Poitiers in his Histoire du monastere de Vezelay (Book 4) says:- "Fire caught by accident in the vault over the sepulchre of the blessed Mary Magdalen, a friend of God; and this fire was so violent, that even the supports called beams by the French, that were placed in the upper part, were entirely consumed. Yet the wooden image of the blessed Maria, mother of God, which was placed on the floor itself of the vault, remained entirely protected from the fire and was only blackened." Is Hugues of Poitiers understood to speak of a wooden vault covering the crypt over the sepulchre of Mary

Magdalen, or of the upper carpentry of the church? What would cause one to believe that the fire destroyed the vault or rather the floor covering a crypt is the rest of the text; the monks having found relics in the wooden image of the Virgin, the surrounding people hastened to see that image so miraculously preserved. Gilon, prior of the monastery, explained b before the multitude of people how should be repaid the acts of grace of the previous discovery, that had been made. "At this recital," adds Hugues, "all wept for joy, and when it was desired to restore under the vault of the sepulchre of the 'beloved of God', there was such a great multitude of people, etc." Thus one can believe that it was the vault or the floor serving as a vault of the crypt, that wes burned. Yet there remains at Vezelay a portion of a crypt earlier than Gilon, (1165) and this part is vaulted with rubble; the other part of the crypt under the sanctuary dates from the last years of the 12 th century, i.e., was rebuilt after the fire. Thus one can admit, that under the sanctuary in the 12 th century existed a sort of raised floor under which was deposited the body of Mary Magdalen, and on which stood the wooden image of the Virgin.

CUISINE. Kitchen.

We have no accurate idea of what were the kitchens and their dependances among the Romans. Were they included within t the houses as in our days, or were they arranged in separate buildings? The last hypothesis seems to us the most reasonable. It is to be presumed further, that the families in Rome, who did not posses numerous slaves and only occupied rented apartments, sent outside to purchase from the cookshops and other dealers the needed victuals at the time of need, as still practised todan in most cities of southern Italy. The Gauls and Germans, like all primitive peoples, cooked in the open air. Gregory of Tours speaks of these repasts taken in the great sheds or wooden barracks, that the French kings built where they wished to reside for some time; in that case the foods were prepared outside in the midst of vast fireplaces built of bricks and of earth. In the Bayeux tapestry the men of William are seen cooking in the open air; it is true that this scene occurs at the time of the debarcation of his army

in England. Necham [1] remarks that it was customary to place the kitchens near the exterior of the houses, along the road or street. It was then necessary to cross a court to pass from the kitchen to the dining room; the meats were brought on spits and were carved on the sideboards [2] before presenting them to the guests.

Note 1.p.461. Alexander Necham or Nequam was a writer, who lived under the reigns of Henry II, Richard I and John; he has left descriptions of the houses of the 12 th century. Born at S. Albans in 1157, he was master of grammar in that city; he was abbot of Cirencester in 1213. (See Some Account of Domestic Architecture in England. Vol. 2. Hudson Turner. Parker edition. Oxford. 1881

Note 2.p.461. See Jos. Strutt. Angleterre ancienne.

In enclosures of Norman castles of the 11 th and 12 th centuries are frequently perceived circular areas 13.1 or 16.4 ft. diameter, portions of which are calcined; we think that these were primitive kitchens, that were nothing more than a sort of dome of earth with a flue at its top, in which were lighted fires for roasting or boiling meats. While retaining those primitive arrangements, they were perfected. In consulting the Monographie des abbayes de France, [1] there is noted in a cavalier view of the abbey of Marmoutier near Tours a kitchen termed culina antiqua (ancient kitchen).

Note 1.p.462. Lib. S. Genevieve.

This kitchen, whose external appearance is presented in Fig. 1, is a sort of great retort, that may have a diameter of 39.4 ft. outside. The vault in form of a bell is pierced by the p principal chimney at the centre to allow the smoke to escape. It has inside five vast hearths, each furnished with a main flue and lateral flues as shown by the plan (2). Thus the smoke of the five hearths escapes by five direct and six lateral flues, each common to two hearths except those near the main entrance. This triple draft for each fireplace prevents the smoke from returning when the wind strikes one side. It m must further be noted, that the flues are dominated by the t top of the kitchen, and that in such a case, the draft is very insufficient for each fire, and must occur through a single flue. In Art. Cheminee, it may be seen that the constructors often divided the smoke flues, when these fireplaces were

very large. Here the excess of smoke could not find sufficient escape by the direct flues A and whirled around under the half dome of each hearth and escaped by the lateral flues B, each having two inlets C C. If in spite of these precautions the smoke escaped beneath the principal vault, it found there the flues at D, and then the central flue. To make this structure understood, we give (3) at A the section on the line K L, and at B the section on the line K N of the plan. The kitchen of Marmoutier is entirely detached, but is near the refectory.

The same collection gives us the external appearance of the old kitchen of the abbey of S. Trinite of Vendome. That circular edifice possessed internally six fireplaces, each having two flues for the escape of the smoke, between the six fireplaces opened six windows (see plan in Fig. 4) abundantly lighting the kitchen. One will note that the preceding kitchen of the abbey of Marmoutier was without windows, and that the men were lighted only by the fires of the hearths, which sufficiently indicates that nothing was done in these kitchens but to cook meats and vegetables; later the kitchens were lighted by windows; stone tables were placed at the centre for preparing the foods before and after cooking; stoves were placed the mantles of the fireplaces. Before the 12 th century men ate only roast meats and boiled vegetables. The art of stewing was almost ignored. What were then necessary in the kitchen were great open fires, wide hearths suitable for placing numerous and long spits, and for suspending great pots.

The plan of the kitchen of the abbey of Vendome (Fig. 4) gives at A the horizontal section at the level of the hearths, and at B the horizontal section at the level of the windows.

The section (5) made at A on the line C D and at B on the line C E shows the arrangement of the hearths with their two flues. the six upper chimneys F opening at the top of the hemispherical dome and the great central flue are intended to cause a powerful draft, and to carry off the smoke inside.

Fig. 6 gives the external elevation of the kitchen of the abbey of Vendome. Behind each fireplace rises a buttress, caused by the weakening of the circular wall and the passage of the double flues beside the hearths.

This kitchen certainly dated from the 12 th century; it was a charming edifice, perfectly appropriate for its purpose.

Everyone can see today the beautiful kitchen of the 12 th century of the abbey of Fontevrault, a kitchen that still exists, but which passes for a funerary chapel; which proves our perfect knowledge of matters and customs of the middle ages.

The kitchen of that old abbey is decorated internally by c capitals supporting arches arranged in a manner perfectly suited to the purpose intended for the monument. At Fontevrault, better than at Vendome, the locations of the hearths are indicated on the exterior. The fireplaces occupy five sides of the octagon, and form as many great projecting niches between th e buttresses. (See the plan of this kitchen, Fig. 7). The five fireplaces were formerly surrounded by flues now destroyed and closed. Four engaged columns bear four arches, whose keystones are abutted by four little internal flying buttresses A. T The smoke that does not take its natural course by the flues B, finds above three of these four transverse arches, flues intended to take it outside. Above the four transverse arches are turned four small arches changing the square plan into an octagon; in the angles formed by these four little arches opened three flues C destined to remove the excess of the heat and smoke. Then finally a great central flue D, opening at the a apex of a pyramid of eight sides, carried off the smoke that might be formed in the kitchen. All these flues except that a at the centre have been destroyed.

Fig. 8 gives at A the section of that mall on the line K L; at B the section on the line M N, and at C the section on the line O P od the opposite plan. Formerly, openings made in the two walls R lighted the interior of this kitchen, whose entrance is at S.

Fig. 9 gives the external elevation of the kitchen of Fontevrault. We have thought to restore the destroyed chimneys, w whose places are perfectly indicated.

Today, we are visibly far from those barbarous times, when men knew how to satisfy the common needs of life; in our chateaus and our great public establishments we place our kitchens in the ground story or in the cellars, so as to disseminate in the building the nauseous odor; that escapes from these kitchens; or indeed if we place them in separate structures, the rules of good architecture require them to occupy the commons, i.e., the wings almost always distant from the principal

building, so that it is necessary to bring the dishes through long corridors in carts, and that everything served on the t table can only retain a lukewarm heat maintained by warmers.

During the middle ages the kitchens of palaces or monasteries inhabited by a great number of persons were important structures; indeed the kitchen counted for something in everyday life. The examples that we have just presented are actual monuments, well conceived and perfectly executed, one sees how the architects of those buildings have sought to obtain a very active circulation of air; indeed not only was air necessary for the use of such great hearths, but it also contributed to the quality of the foods used in cooking. A stay in those kitchens could not be unhealthy. The architects of the 13 th century must necessarily perfect these dependances of monasteries and castles. They built kitchens in several stories, ju just as we shall soon see; they began by installing stoves t there and not tables for carving the meats before serving them; they took great care to arrange a stone pavement so as to be able easily to keep them clean; sometimes they found means to utilize the smoke of wood for preserving certain meats.

There existed in the abbey of S. Pere or S. Pierre of Chartres a fine kitchen of the 13 th century adjoining the refectory; that was circular and presented in the interior an ingenious arrangement, that permitted smoking a considerable quantity of meats. Either for the internal consumption of the monastery or for sale, the monks raised herds of swine, from which they made a product esteemed by lovers of salt pork and smoked hams. The great kitchen of the abbey of S. Pierre of Chartres was arranged so as to be able to smoke a considerable quantity of meats.

Fig. 10 presents at A the plan of the ground story, and at B the plan of the second story of this kitchen, built on a c circular plan like the preceding. The hall contained six hearths C surmounted by a vault forming a sort of side aisle with an upper gallery. The smoke from the hearths passed through the openings D of the vault, and spread in the gallery E, whose walls were hung with hams on hooks. These two stories received external light by the windows G. After having swept around the upper gallery E, the smoke was led outside by the six flues H and by the central chimney K. The drawings and e

engravings, that we have been able to consult [1] do not give u us the exact dimensions of this structure, but one can recognize that it was quite large, and that it must have had 39.4 or 45.9 ft. diameter.

Note 1 p.472. Se Monog. d'abbayes de France. Lib. S.Genevieve.

Fig. 11 presents at A the section on M N, and at B the section on K L of this kitchen. One sees in section A the cells over each hearth against the walls on which were hung the meats. Buttresses rose behind the six hearths, both to abut the thrust of the vaults as well as to give stability of the points in the circumference at which the heat of the fires might crack the walls, as too frequently happens. By opening the l lower windows was established a current of air that increased the draft of the smoke through the hole D, so as not ts inconvenience the cooks; but the smoke filling the cells in the s second story then escaped more slowly by the six flues H or by the central chimney. Thus there remained permanently in the upper gallery smoke seeking its exits, and the meats also had time to become impreganated by it; but the smoke could not r return to the ground, due to the great central chimney, that established a powerful draft.

The external appearance of the kitchen of the abbey of S. Pierre of Chartres is presented in the elevation (12). Here the covering is made of carpentry covered by slates, and one sees how the great central chimney was maintained by eight f flying buttresses indicated in the sections. To avoid steam, that could not fail to form under the central vault, if the e extrados of this were in contact with the external air, the roof was raised and ventilation was established between the extrados of this vault and the carpentry. That isolation also permitted examination of the roofing and preventing leaks of rain.

The small area at disposal in castles and especially in palaces built in populous cities did not always permit the building of detached kitchens. They were forced to find their place in these buildings; but again in that case they were arranged with the greatest care and so as to not diffuse odor or smoke outside their walls. One still sees in the old structures of the palace of justice of Paris a hall vaulted on a quincunx of columns (13), with four wide fireplaces at the angles. Tn

This hall looks out on the north quay beside the tower of the Horloge, and is known under the name of S. Louis' kitchens. Yet this structure belongs to the end of the 13 th century or the beginning of the 14 th, and is contemporaneous with the works erected by Philip the Fair. The mantles of the four fireplaces form in horizontal projection an obtuse angle, and their keystone is abutted by a sort of stone strut, as indicated by Fig. 14. Examination of the locality causes us to suppose that this kitchen had two stories. The lower kitchen, which now exists entire, was probably reserved for the courtiers, a and the upper story for the service of the table of the king. In the palace of the Popes at Avignon still exists a kitchen of the 14 th century; it is a vast pyramid with eight sides, hollow and built in a square tower, terminated by a single c chimney; hearths are arranged in the lower walls. One does n not fail to show this hall to visitors, as being that where the tribunal of the Inquisition had men roasted with closed d doors. To roast men on a public place or in a tower for the greater glory of God is certainly a dismal means of bringing means of bringing them into the way of salvation; but to take the kitchen as a place for roasting human beings is a very r ridiculous mistake.

Yet in castles as much as possible, and as practised in the monasteries, the kitchens were placed in a separate building, Here is one of those kitchens from the end of the 14 th century, perfectly preserved, that belongs to the castle of Montreuil-Bellay near Saumur.[1]

Note 1.p.477. This castle once belonged to a duke de la Tremoille. We owe these drawings to M. Potouille, who has kindmade for us an accurate drawing of this little structure.

The plan (15) is square, in the interior are only two fireplaces A a. Stoves or soup kettles were probably placed at F. The two fireplaces each had their draft flue' at the centre of the vault is also another tall flue designed as usual to remove the steam formed in the interior of the room. This k kitchen is attached at one side to a great hall B of the castle. Two small side doors are at C C, the latter openiug on a gallery. There is still seen a third door at D, then at E is a very wide windou with wall under, arranged like the front of a shop. Through this window was brought and received the

provisions from outside, and indeed is to be seen a trace of the little hood on the exterior, that sheltered the men stationed before the opening. The hood extended by means of a little suspended roof to over the door D.

The construction of the vaults is most curious to study, it shows us again how the architects of the middle ages freely utilized the principles, that they had discovered. Let us first give the section (16) of the kitchen of Montreuil-Bellay on the line O P of the plan. The central vault is a curvilinear pyramid of four sides with projecting ribs in the four reentrant angles. These ribs are of stone and the curved sides are of brick; the projecting ribs support a circular stone ring, that receives the square central brick chimney, terminated by a lantern of cut stone, on the four sides of the square forming side aisles are turned tunnel vaults, those before the fireplaces being penetrated by their hoods. But to abut the four transverse arches and the two very heavily loaded ribs the constructor has turned half arches forming a sort of flying buttress turned toward the external walls. Thus these arches thrust a little outside and strongly maintain the central vault loaded by a heavy chimney. If we then cut the building on the line R S of the plan, we obtain the sketch (17), in which one sees in section how the diagonal arches L at the angles stay the four ribs of the central vault. Under the window at the right was probably placed one of the stoves or soup pots, and that window permitted the examination of the foods placed on that stove. Dating from the 14 th century, the use of sauces was very much approved in the art of cooking; men were no longer satisfied to serve on the tables roast or boiled meats. Stoves were necessarily required for preparing these condiments made more varied than in our days. At the beginning of our (19 th) century, a celebrated cook claimed that the English customs introduced in the culinary art were a loss to the art, that these were an evident return to barbarism; with the seriousness belonging to every cook sure of his merit, he sadly predicted the decadence of sauces, and consequently of society. The section made on the line T V of the plan gives the sketch (18) indicating how the hood of the fireplace penetrates the lateral vault, and how the flue must slant to the vertical wall. Fig. 19 presents the external el-

elevation of the kitchen of Montreuil-Bellay, at the side with the window for provisions.

The court of Burgundy attached great importance to the service of the table, and during the 15 th century it was in the entire West, that where one ate and drank best. The descriptions of the feasts given by the dukes of Burgundy, that have been scrupulously preserved for us in the memoirs of Olivier de la Marche, permit one to suppose, that to prepare such a g great number of varied dishes were required kitchens and offices arranged in the grandest fashion. Yet many dishes were c cooked in advance; but a prodigious number of soups were served, of meats prepared with sauces, of stews, hot fish, and then pyramids of poultry or roast game. It was necessary for these dishes to be cooked at the time of the repast. Then in the vast kitchens of palaces or castles were only heated the hearths of vast fireplaces, before which long spits received the meats, but the andirons of these fireplaces supported small stoves at their tops, the soup kettles were heated by charcoal, then the tables on which were placed glowing embers, also served as a supplement, either for quickly making gravies or for dressing the dishes. They men adhered strongly to eating hot meats while warm, and one can understand how in t those vast kitchens all equipped with hearths, the foods had no time to cool while they were placed in the dishes. The good arrangement of the chimney flues, and especially this central draft found in all the kitchens of the middle ages, constantly renewed the columns of air, and prevented the cooks from being suffocated, in spite of the extreme heat.

Since we have spoken of the table of the dukes of Burgundy, we must not omit the fine kitchen built during the second half of the 15 th century within the palace of the dukes of B Burgundy at Dijon. That hall and its dependances were still entire some years since. Its plan is a perfect square (20); the central vault is supported on eight columns; at three sides these columns serve as jambs of three great double fireplaces A, whose hearths are only divided by pointed arches, and are surmounted by double rectangular flues. Two soup kettles or stoves are arranged at B; at C is an oven and at D a well with duct E communicating with one of the hearths. Thus one could fill the great kettles or boilers, that were proba-

probably suspended over one of the three hearths. This kitchen is lighted by high windows F and by a little lateral window G. At H rises the central chimney designed to remove the steam. At K a stone table received the foods after cooking t them. The officials took them there to arrange them on the dishes. The slab of that table was heated underneath, so that these dishes could not cool.[1]

Note 1.p.482. See Vol. VIII, po 253, of the Bull. mon. pub. by M. de Coumont.

Fig. 21 gives the section of this kitchen on the axis A'B'. The central chimney is supported on a small vault with square base (cloister vault), that rests on the great central vault reinforced by four diagonal ribs in the reentrant angles. These eight arches meet at an open ring at the centre and around its perimeter, as shown by the prespective detail P. According to custom a lateral sewer R received the water thrown on the pavement of the kitchen to keep it clean. The hearths were well arranged and included all the space afforded by the side aisle at their sides. The hoods were wider than those of the castle of Montreuil-Bellay, eyd must carry off the smoke perfectly, and render the construction more simple.

The kitchens of the middle ages, as we have just stated, n nearly always contained stone tables or warmers, on which were deposited the meats and stews before carrying them into t the hall of the feast. There still exists in the kitchen of the abbey of Mortain (Abbaye Planche) two of these warming t tables cut in granite, that we give here (22).

Our neighbors beyond the channel as well as we, appear to have arranged the kitchens of their monastic establishments or castles. There is seen at Durham a beautiful octagonal fireplace of the 14 th century, with its dependances, offices, storeroom for wood and charcoal, etc. Whatever the dimensions of the fine arrangement of these kitchens of the middle ages, in certain cases they became inssufficient for preparing food for great assemblages, the more so that then the lords kept o open table for all comers. For the coronation of Edward I in 1273, all the area of vacant lands within the walls of the palace of Westminster was entirely covered by temporary sheds a and offices to provide food for all that presented themselves. Numerous kitchens were also built in the same enclosure; but

in the fear that these would not suffice, lead boilers were placed in the open air. The principal kitchen, in which poultry and other choice meats were to be cooked, was entirely uncovered to permit the smoke to escape easily.[1] To make of a kitchen a special detached building, perfectly suited to t its purpose, would have been for the architects of the Renaissance, to dismoder the order of architecture. Since then it has been desired to disguise these essential services, they are relegated to the cellars, or placed as may be in the main building, with the risk of inconveniencing the occupants of the chateaus. It is first desired to present symmetrical facades and regular courts, but since it is necessary to dine, whatever love one may have for symmetrical architecture, the odor of the kitchen and the noise of the servants extends at certain hours through a good portion of the palace. In public establishments, such as asylums, barracks, seminaries, monasteries and colleges, instead of the great well ventilated rooms well arranged in the middle ages, men have been compelled to take in the ground story or underground (always to satisfy t the rules of beautiful architecture) a room often surrounded, dark and damp, difficult of access, to install there the kitchen and its dependances, instead of those broad hearths, before which meats roasted while absorbing as much oxygen as t they could take up; there have been placed stoves suited (it is said) for all sorts of cooking, equipped with ovens, from which all foods come after having acquired nearly the same t taste. In these cast iron loboratories the meats do not roast but dry up; vegetables while boiling take an insiped flavor; air is lacking to these different dishes, and air for a great part enters into their nutritive qualities. Chemistry declares that a leg of mutton cooked in the open air or in one of these cast iron crucibles presents the same elements on analysis, w we admit it, but our palate, that is not a chemist, perceives a great diffeeence between them; our stomach digests badly t those foods smothered in cooking, dry without savor. It is t true that we can aid digestion by going to see the beautiful regular facades of our public edifices, count the number of their columns, of their arches and windows.

Note 1.p.484. See Dom. Arch. of the middle ages, 14 th century. p. 65. Oxford. Parker.

You, architects of our old castles, our old hospitals, our religious houses, what would you say if you enter most of our public establishments, if you see how are arranged the services most essential to the common life? 1

Note 1.p.485. Since this refers to kitchens, it must indeed be recognized, that in many of our establishments of public i instruction and barrecks, particularly in most of our seminaries, the sight of those offices is made to take away any appetitte from those most hungry.

CUL-DE-BASSE -FOSSE. Dungeon. Oubliette.

If we credit most of the writers that have treated of the middle ages, who have attempted to trace the customs, there was not a monastery or castle in France, which did not have in its foundations at least one oubliette destined to receive those men, that were desired to disappear. We have seen ma many castles and a good number of monasteries, and we have never been able to find this sort of oubliette in form of an inverted cone, said to be destined to receive unfortunates, that were not only deprived of the light of day, but who could neither sit nor lie at the bottom of these pits. When during the middle ages it was desired to make a man disappear, h he was hung high and quickly, then cast into a pit, or he was simply killed, taking care to bury him in some remote corner; but men rarely amused themselves by these strangely barbarous refinements. All castles containing deep cellars opening only by a hole pierced in the vault, cellars that were actual storehouses for receiving grain, roots and provisions, but in which was placed no person. Sometimes these pits are built as inverted cones; they are then icehouses. Some have also desired to see in a great number of privy vaults oubliettes, and there is not a castle in which the guide of the place does n not show you privies raised to the rauk of oubliettes. The p prisons and dungeons exist in nearly all monasteries, castles and official buildings; but these prisons are perfectly arranged for the intended purpose, they are unpleasant, but they are only rooms more or less large, more or less lighted or entirely dark; they are not oubliettes. Those who built them a appeared to wish to make them safe but sanitary, as much as prisons could be made.(Art. Prison).

CUL-DE-FOUR. Half Dome.

Vault of a quarter sphere resembling indeed the back of a bread oven. The semicircle containing the tribunal of the R Roman basilica was covered by a quarter sphere; that arrangement was imitated during the first times of Christianity and persisted in the East until about the middle of the 12 th century. (Arts. Architecture Religieuse, Cathedrale, Construction, Eglise). In the primitive Roman church the clergy was arranged around the semicircle, and the altar was found between the choir and the believers. Windows were pierced in the semicircular wall of the apse and lighted the assembly of the c clergy, above these windows was built the half domical vault, usually decorated by paintings or mosiacs. (Arts. Mosaique, Peinture). One still sees in France many apses vaulted by h half domes in Poitou, Normandy, Auvergne, Lyonnais and Burgundy. It sometimes happens that the vaults of the naves and transepts are already Gothic in the system of construction, and that the apses retain the Romanesque half domes. One can cite the cathedral of Langres among other remarkable examples of this kind. The form of the quarter sphere had been so well adapted for apses in the first times of the middle ages, that it seemed consecrated; the clergy only renounced it with difficulty when Gothic art, entirely adopted in religious structures no longer permitted the mixture of the former methods of construction.

CUL-DE-LAMPE. Pointed Corbel.

We have adopted the system of giving in this Dictionary the words sanctioned by use, without discussing their etymology or value; but we must confess that the word "cul-de-lampe"as applied for two or three centuries, is justified by no good r reason. The bottom of a suspended lamp terminating in a point could give the idea of applying the name to certain pendant keystones of the 15 th and 16 th centuries; but men did not stop there; they gave that name to every corbelled support, t that is not a corbel, i.e., does not present two parallel surfaces perpendicular to the wall. And to avoid longer explanations (1), A is a corbel and B a "cul-de-lampe". For lack of a better term, we then accept it.

The Romans employed pointed corbels, or rather consoles and

corbels to support little orders of columns attached to the surfaces. This was one of the traditions of the late empire, that the middle ages retained and perfected. This principle was purely ornamental in Roman architecture, and even became one of the means of construction most commonly employed during the Romanesque and pointed periods. During the Romanesque epoch, because the first who had the idea of placing vaults on the plan of the Roman basilica, after having erected in place of the slender antique Ionic or Corinthian column, heavy cylindrical piers A (2) were much embarrassed to know how to find points of support for the imposts of the transverse arches. They then thought of placing over the junction of the archivolts of the side aisles projecting stones, on which then raised then the engaged columns G. They generally gave to these projecting stones the form of a pointed corbel, because indeed that form diminished at the bottom best accorded with the junction of the two extradoses of the archivolts. It is unnecessary to state that these primitive pointed corbels are barbarous; they are sometimes merely inverted cones slightly fluted (3), or human heads and those of animals rudely sculptured. But these pointed corbels by their position itself attracted the eye; sometimes placed near the eyes, men sought to make of them remarkable works, when Romanesque sculpture bacema l less rude, the execution was entrusted to the most skilful h hands. Already in the provinces that possessed good schools of sculpturs at about the end of the 11 th century and beginning of the 12 th, one finds pointed corbels as remarkable by the style as the purity of their execution. One of the most beautiful that we know from that epoch is found at the entrance of the choir of the upper church of Chauvigny (Poitou), it supports a column of the transverse arch, and was placed to take the lower part from the pier, leaving more width to the nave for placing benches and stalls.

Note 1.p.487. See the ruins of the palace of Diocletion at Spoloto.

We give this pointed corbel (4) in front at A and in profile at B. By its style this sculpture recalls the best Greek Byzantine sculpture. Where did these western artists of the beginning of the 12 th century obtain those types? That is what we shall examine in Art. Sculpture.

There existed in the refectories of the abbeys of the 12 th and 13 th centuries pulpits for readers, that were supported on magnificent pointed corbels, according to authors that had seen them, for there no longer remain only mutilated traces of those sculptures. The pointed corbel of the pulpit of the reader of S. Martin-des-Champs at Paris (Art. Chaire, Fig.3) passed for a masterpiece. These last pointed corbels were composed of several corbelled courses, and the ornamentation was combined according to the height of the courses or extended over all; most frequently it was a tree putting forth branches and leaves mingled with birds. When the system of vaulting really belonging to the middle ages was invented, these vaults consisting of independent members, transverse, diagonal a and side arches serving as ribs for the filling, the arches sprung from the construction; they must then either rest on piers forming projections from the faces of the internal walls, or on corbellings, pointed corbels. In halls that by their p purpose must be surrounded by benches, wainscoting and furniture, men avoided with reason supporting vaults on piers, whose projections might have been inconvenient. Then the pointed corbels frequently played a very important part; for if the different arches of the vaults were strong and numerous, it was necessary for their pointed corbel to form a broad and projecting bearing.

In the old abbey hall of Vezelay, known now by the name of the low chapel, a hall that was nothing but a sacristy or a place of assembly for the religious before passing into the choir, the vaults of the 12 th century, round arched but constructed with pointed vaults, rested on pointed corbels formed of three courses and an impost (5). This sculpture was destined to be seen very near, since the lower course is not more than 6.6 ft. above the floor, and is executed with much refinement, while leaving to the stone all necessary strength.

More even that the Romanesque epoch, the 13 th century desired to diminish the importance of the points of support on the floor and to remove all projections from the interiors, and did not fail to employ pointed corbels for supporting the vaults. The sculpturs of that epoch enriched them by figures, sometimes quite important, by heads and especially by foliage; they even went to give them entire compositions, especially if

they needed to give to these pointed corbels a strong projection to bear wide and deep arches. Even then, in the fear that the imposts of these arches might split under the load of two or three courses composing the pointed corbel, they set a first corbel, then a projection on this corbel, finally placing the second; thus they distributed the load over a greater height, and did not have to fear ruptures.

There is still seen in the angle of the north transept of t the cathedral at Agen a pointed corbel composed on that principle, and which by itself is a little monument receiving two great side arches and a transverse arch of great span (6). Th The construction of this support is no less remarkable than its design. The first course, the true pointed corbel is at A, deeply engaged in the two surfaces extending at right angles. The upper bed of this course is at B. The figure and the work behind it up to the band C is a single block of stone. The t two side columns are detached, and each in one piece of stone set on end; their capitals are engaged in the walls; the upper band receiving the impost of the diagonal and two side arches is also engaged in the construction. In plan this corbel gives the sketch (7), assuming the horizontal section made at the level D. This corbel is placed at a very great height and the execution is coarse.

Burgundian architecture is rich in pointed corbels of very remarkable originality and beauty of execution. The resistant nature of the limestones of that province authorizes boldness, that one could not permit in Ile-de-France, Champagne and Normandy, where the materials are generally od a nature less firm. The school of Burgundian sculpture of the 12 th and 13 th centuries further is endowed with a strength and fertility in c composition, that we have many times had occasion to mention in the course of this work, and whose development we shall explain in Art. Sculpture.

The little church of S. Pere or rather S. Pierre-sous-Vezelay, among other Burgundian edifeces, presents a great variety of pointed corbels, Here are two (8, 8 bis), that receive groups of columns separating the arches and vaults of the nave; they are each composed of two courses, that are perfectly indicated in the arrangement of the ornament. One of these c corbels represents the vice of avarice ander the form of the

bust of a man with a full purse hung on his neck, two dragons devour his ears, remaining deaf to the complaints of the poor.

To make understood the different modes of rendering the same motive by the schools of architects of the same epoch, we give (9) one of the corbels supporting the clusters of little columns of the vaults of the lantern of the cathedral of Laon. T This corbel is little earlier than the two last. One sees how the sculpture of Ile-de-France is restrained, if we compare it to that of Burgundy. It is scarcely possible to compose in a simpler and more graceful manner a support intended to bear three little columns by corbelling. This angel's bust that p projects from the wall appears to lean on the course serving it as a starting line, by its natural pose it appears to carry without effort the three shafts, so well placed on its head and its two wings.

Burgundy surprises by the boldness of its conceptions, its plant sculpture, abundant and broad, cut in hard stone by skilful and sure hands, charms us; never did its school attain that purity of style and delicacy of taste, that we find in t the royal domain, Champagne and Beauvoisois, after the 12 th century.

Sometimes the pointed corbels take the form of a simple capital without a column; thes capital is engaged in the wall, a and in place of the astragal the sculptur has cut a bunch of leaves. Beautiful corbels of that kind are seen bearing the low arch of the side aisle of the choir of the cathedral of Auxerre; but these do not have the breadth of execution of t the two or three corbels that hold a similar place in the aisles of the little church of Clamecy (10).(About 1230). The Normans, who are reasoners, desire these pointed corbels to spring from the wall just as vegetation springs from the joints of the stones. Here (11) are several corbels supporting t the corbelled gallery, that surrounds the piers of the nave of the cathedral of Rouen above the archivolts (about 1230), presenting that peculiarity. Sometimes in Normandy the pointed corbels are also composed of a capital placed on the end of a column bent at right angles and penetrating the wall. The Normans did not understand in the 13 th century, that a capital remains suspended without support.

At the middle of the 13 th century, the columns or little

columns receiving the imposts of vaults are no longer borne by corbels; they descend to the ground, thus pointed corbels are rarely employed, except to support statues, attached to these columns, or accessory architectural members. Thise kinds of corbels are found very frequently built into edifices after the end of the 13 th century.

One sees in the interior of the upper S. Chapelle of the palace at Paris beautiful pointed corbels attached to the shafts of the columns receiving the principal arches of the vault. These corbels to the number of 12 bear the statues of the apostles at life size; they are very rich, and cut in the height of one course of lias stone, and consist of a slab or moulded abacus, whose fillet is incrusted with stained and gilded glass, with a very slightly curved and very flat bell, c combined with the shaft of the column. Around these corbels are grouped tufts of leaves carved with charming flexibility, painted and gilded (12). These corbels perhaps do not have a character sufficiently monumental; but it should not be forgotten that they are placed in the interior at about 10 ft. from the floor, and that as well as the statues, they are all made to break the dry lines of the columns ascending from the bottom.

The internal sculpture of the S. Chapelle of Paris is most delicate, and already in the edifice the imitation of the flora is carried very far.

If the take one of the corbels serving as support of some statues decorating the western gable of the church of S. Pierre-sous-Vezelay (13), we shall again prove the differences of style, that separate the sculpture of the French and Burgundian schools.

The composition of the internal corbel of the S. Chapelle is wiser and particularly more refined than that of this Burgundian corbel (both date from the middle of the 13 th century); but in this last ornament the monumental character is c certainly better felt; its composition is broad, like the execution; there is a strength and a remarkable firmness of style.

Let us state in passing, that nearly always corbels placed either in the interior or on the exterior of edifices are painted in vivid colors; the grounds are red, reddish-brown or slaty-blue, the leaves are light green, yellow ochre or gold. Men then strongly held to giving these supports a great deco-

decorative value, to make them prominent.

Sculptors during the 14 th and 15 th centuries, to decorate the corbels supporting statues, chose by preference the representation of the vices opposite to the qualities of the personages they were intended to receive, or again the figures of their persecutors, or the scene of their martyrdom. Many of our old statues of churches having been broken during the religious wars or at the end of the last (18 th) century, the c corbels merit study from the point of view of iconography, f for they can serve in determining the statues placed above t them. Thus under the statue of S. Peter is frequently seen t the figure of Simon the magician, and under that of the Virgin is the dragon with a woman's head. For the person famed f for his continence the corbel represents a scene of lewdness (14); [1] this is a young noble seeking to violate a nun.

Note 1.p.500. Corbel of the 14 th century placed on the interior of the south wall of the cathedral of Auxerre. the statue is wanting.

Beneath the feet of Christ teaching, whose statue is attached to one of the piers of the old cathedral of Carcassonne at the left side of the entrance to the choir, is sculptured a magnificent corbel, that seems to us to represent Judas after his condemnation. A dog or an unclean beast is tearing him. Vine leaves crown this scene (15). [2]

Note 2.p.500. This sculpture dates from the beginning of t the 14 th century.

Some of these vices are too frankly rendered, and have caused it to be supposed that the sculpturs of the middle ages p pleased themselves by placing under the eyes of the public s scenes rather lively, even in the churches. A false zeal or often an imagination to easily excited have thus placed to the account of those artists misdeeds, that they did not commit. Until the 14 th century one can see in these representations only the image of a vice in opposition to a virtue. Besides, before that epoch there was great restraint in the mode of r representing these vices. Later when the arts of the middle ages fell into affectation and the puerile imitation of nature, it appears evident to us, particularly if one refers to the customs of the 15 th century, that the artists having to personify vice pandered to the spectators in the representation

of scenes explaining that vice to the observers. These abuses have existed in epochs of decadence, and the arts of the two last centuries did not fail to fall into it. (17 th and 18 th).

The corbels supporting the imposts of arches or statues often appear in the architecture of the 15 th century, and they show the taste of that period. Their abacuses are often concave sided (16); they are elongated and are composed of two or three courses. Geometrical lines assume importance.

The sclupture reproduces subdivided leaves frequently imitated with a perfect study of nature. The entirety of these compositions however does not fail to present confusion, are too labored with too delicate details, and that are not in scale with the edifices. These are little masterpieces, that the s stonecutters are pleased to fashion lovingly in their workshop, outside the direction of the master of works. One no longer feels in these compositions the monumental harmony, that we always find during the 12 th and even also during the 14 th centuries.

At the end of the 15 th century pointed corbels, especially in civil architecture, are employed with prodigality, and present masses better combined and more varied than those of the middle of that century, that weary by the uniformity of the geometrical forms and the labored sculpture. There existed in the mansion de la Tremoille at Paris very beautiful corbels under the vaults of the portico and in the grand stairway, whose newel is preserved at the Ecole des Beaux Arts. One of the great corbels of that portico, that we give (17), represents an angel with a child at its right bearing a palm leaf; on the left this angel seems to repulse a little siren, the emblem of lewdness as all know. Was this innocence or chastity protected by the guardian angel? [1] Also sometimes corbels belonging to civil edifices represent scenes froc the romances or tales known to all.

Note 1.p.503. This bracket, of which we made a drawing before the destruction of the mansion de la Tremoille, is probably lost, for we have not found it among the fragments placed in the court of the Ecole des Beaux Arts.

In the 15 th century, heraldic arms, emblems, scenes recall certain events of the life of the nobles or citizens who built. Thus in the charming mansion of Jacques Coeur at Bourges, behind a wardrobe destroyed several years since, was found a ve

very curious corbel. This corbel is placed in the hall that passes as having beeu the treasury (not without reason), the cabinet of Jacques Ŝoeur. Indeed this hall is well closed by an iron door, and it is found in one of the old towers against which the palace is built. It even seems that the wardrobe, that coucealed the corbel was placed there from the origin of the building, for the old tiles did not exist below it.

Here (13) is a representation of the corbel in question.

At the left is a fool holding a bouble in his right hand, the left trying to catch flies placed on the trunk of a fruit tree. Turning his back to that figure and in the middle of t the corbel is Jacques Coeur (or at least a person recalling his features) in the elegant costume of a noble with a dagger at his side. With his left hand he points to a small square basin at his feet filled with water, in which is reflected t the image of a bearded head, crowned and placed in the tree above the fountain. A scroll extends to right and left of the royal head.

On the right is a woman lying on a rich rug thrown on blossoming grass; she is crowned and raises the right hand to her crown as if to remove it; with her left she raises the bottom of her robe trimmed with fur. A very rich collar surrounds t her neck. The right end of the corbel is occupied by a third tree. The gesture of the woman is rather equivocal, the bearing of the man is discreet; ouly he seems to advance with mystery. We do not know any tale, account or romance that can e explain this curious sculpture. One would be tempted to see in it an episode of the life of Jacques Coeur, who had been accused by his enemies before the king, to overthrow him with more certainty, of having purchased the favors of Agnes Sorel. Here the personage that we believe represents Jacques Coeur appears to be solicited by the reclining woman; by indicating the image of the king reflected in the fountain, he seems to indicate the witness of that scene and to recommend prudence.

If this sculpture was executed before the disgrace of Jacques Coeur, although it was placed in a secret place, it must be confessed that it was a singular conceit or act of imprudence. If only sculptured after his restoration (which would seem more probable), that would cause i to be supposed, that he desired to place before his eyes the memorial of one of t

the principal causes of his misfortunes, as a perpetual lesson. The person of the fool would add weight to the last hypothesis. Is it not there to show that libertines with gallant adventures, were these of a nature to flatter their vanity, resemble the fool that passes his time in catching flies?

However that may be, this example sufficiently explains why the sculpture of the corbels in the edifices of the middle a ages merits observation; it may sometimes aid in explaining facts belonging to the customs, or certain historical episodes of great interest.

Here (18) is a reproduction of the corbel just described,[1] the lower part of which is unfortunately mutilated.

Note 1.p.304. Notice pittoresque sur les antiq. et mon. du Berri, published by M. Hoze. 1834. M. Hoze first mentioned t the existence of this curious sculpture in the mansion of Jacques Coeur.

From the 12 th century, the constructors frequently supported turrets containing stairs,or serving as lookouts on angle buttresses; but the perimeter of these turrets projecting for part of this area, is indicated in the plan (19), there remained the triangles A, which it was necessary to support by c corbelling, whose lower course at least was cut in the form of a pointed corbel.

The remains of a building of the castle of Vees near Morienval shows us also an angle turret of the 12 th centurw, which is thus supported in the reentrant angles by corbellings commencing with a pointed corbel (20) cut in the form of the end of a beam. (Arts. Echauguette, Tourelle). It is very rare to find corbellings of turrets with pointed corbels sculptured during the 12 th and 13 th centuries; still we possess some examples of them an a beautiful style.

Certainly the most remarkable are seen beneath the stairway turrets of Notre Dame of Dijon, first half of the 13 th century. It is still in Burgundy, that we give here (21) a specimen of its school of sculptors. This corbel is composed of three courses, each of a single block. In the wide hollows twist or ramp fanciful animals, sculptured with strong energy and extreme skill. The faces of these beasts are rendered by a sculptor observant of nature, although he could only take his models from his imagination,[1]. When one examines closely this s

singular menagerie,[1] he is struck with astonishment before t the realism given by the hand of the artist to those impossible beings. All bear the character of brutal ferocity belonging to the wild beast. Their members are attached by an attentive and knowing observer. But all the sculpture of the facde of Notre Dame of Dijon would be worthy of being cast and placed in a museum, it is the masterpiece of the Burgundian school of the 13 th century.[2] These corbels, like all the sculpture of that facade, were painted. The architects of the middle ages had so fully adopted that habit of coloring external corbels, that under one of the angle turrets of the synodal hall of Sens, that dates from about 1245, there exists an owl in the form of a support; this owl was painted red, although there are no traces of coloring on the rest of the exterior of the edifice. After the example just given, the sculptured corbels beneath the turrets of the 14 th and 15 th centuries would appear common. so we limit ourselves to these; besides, these corbels are generally composed of bands of leaves presenting nothing in particular. At its origin, the Renaissance did commit the fault of employing pointed corbels in architecture; but these last corbels nearly always reproduce the form of a capital without a column, possessing a base in form of a rosette beneath the lower bed, instead of the astragal.

Note 1.p.306. These corbels are placed at the height of about 33 ft.

Note 2. It is to be desired, that this beautiful edifice be cleared and preserved by a skilful hand, from the ruin that t threatens some of its parts, and notably the facade. We shall make known the combination in Art. Construction.

CUSTODE. Tabernacle. Pyx.

Thus is called the isolated shrine or a cupboard destined to contain the holy eucharist, the holy oils or the sacred v vessels; the same name [1] is also given to the veils, that were designed to conceal the eucharist contained in a suspended case. (Art. Autel). The little ambries made in the walls of chapels,behind or beside the altar, are actual tabernacles. (Art. Armoire).

Note 1.p.307. In Latin custoda or custodia. (see Du Cange, Gloss., also Art. Tabernacle in Dict du Mob. Franc., etc.

CYBORIUM. Ciborium.[1] Baldachin. Canopy.

Note 1.p.508.(Latin note).

This Latin word is employed in French to designate the canopy or shrine, that in certain cases entirely covered an altar. This is what has been designated as a baldachin since the 16 th century. The canopy that covers the main alter of S. P Peter at Rome is an actual ciborium. At Paris the altars of t the Invalides and of the church of Val de Grace are each covered by a canopy in modern style.[2] During the middle ages a canopy was also placed on the tomb of a saint or a person of prominence.

Note 2.p.508. At Nimes in the church of S. Paul, the architect M. Questel, has erected over the altar a canopy in Romanesque style. In the cathedral of Bayonne, M. Boeswilwald has also just constructed over the prencipal altar a canopy in G Gothic style. At Rome the basilicas of S. Clement, S. Lournet, S. Agnes-w-t-W., etc., are seen canopies placed over the altars, that date from the 12 th, 13 th and 14 th centuries.

The canopy was usually made of precious materials or was c covered by sheets of gold or silver.

In France it was not a common custom after the 13 th century to place canopies over altars. (Art. Autel). These were e enclosed by columns supporting veils, were composed of a simfle table with a suspended tabernacle. but these altars were not covered, while in Italy most of the principal altars possessed a canopy. Yet in France some altars of Romanesque abbey churches had canopies. In the life of S. Odilon, abbot of Cluny,[3] is read this passage:- "He also commenced a canopy o over the altar of S. Pierre, and covered the columns with silver plates ornamented by beautiful niello work.[3] Unfortunately we do not possess of those canopies of the Romanesque more that descriptions as brief as this; it is then difficult to give an exact idea of their form, composition or importance. Some Rhenish ivories of the 11 th and 12 th centuries indeed show us canopies over the altars, from which are suspended veils; but these representations scarcely instruct us more t than the old descriptions, for these monuments are represented in an entirely conventional manner, they consist of four columns bearing a sort of dome, surmounted by a cross.

Note 3.p.508. Vita S. Odilonis, Abb. inter SS. Bende. Sect 6.

Note A.p.508. Latin note.

It must be stated that unless they assume considerable dimensions, canopies restrict the ceremonial adopted today at the principal altars of important churches. For cathedrals, canopies were contrary to the arrangements adopted in the 12 th century, since the bishops, in rebuilding their churches, on the contrary held that the altar should be free, and that it could be seen from all parts of the church.

TABLE OF CONTENTS.

RATIONAL DICTIONARY

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FRENCH ARCHITECTURE

From XI to XVI Centuries.

By

EUGENE EMANUEL VIOLLET-LE-DUC

Government Architect

Inspector General of Diocesan Edifices

Volume V

From Gable to Ouvrier

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DAIS. Canopy. Hood.

The name given to projecting stones more or less ornamented by sculptures, destined to cover statues on exteriors and even in the interiors of religious and civil edifices of the m middle ages. The artests of that epoch did not find it proper to place a figure of a saint or a celebrated personage against a wall without protecting its head from the rain or dust by a sort of small canopy belonging to the structure. Yet only dating from the 12 th century, canopies almost without exception were placed above external statues. Sometimes in that epoch, as for example on the front of the porch of the church of Moissac, canopies were merely a low course or slab cut in arch form at its sides (1). Yet one sees in the monuments of the 12 th century richly decorated canopies already, and that represent little monuments suspended over the statues. The church of S. Sauveur of Dinan shows us two canopies beside the p portal, important in size and delicately wrought, that cover the figures of saints. Cut in friable granite, they are unfortunately very much changed by time. Sometimes statues being placed against columns, the canopies are also fixed to their shafts. Then the column and the statue, its support of the c canopy are all cut from a single block of stone. On the royal portal of the cathedral of Chartres are noted, suspended over the heads of the figures from the 12 th century, that decorate those portals; several canopies in a fine style. we give one of them here (2).

Canopies frequently furnish us with varied motives of the crowning parts of edifices, i.e., of certain parts of these edifices, which ara almost always destroyed or modified. It is to be noted even in the 12 th and 13 th centuries, that these little models generally reproduce examples of edifices before the epoch at which canopies were sculptured. This fact may perhaps be observed above the statues of the central portal of the western facade of the cathedral of Paris (3). These canopies again represent domes and flat roofs, such as were no longer built in that part of France.

The canopies protecting the statues of the 12 th century a and of the beginning of the 13 th, placed in the jambs of the portals, are cut on a different model. Each statue has its s separate corbel and its canopy. Yet there is a very remarkab-

remarkable exception to that rule at the portal of the Virgin on the western facade of Notre Dame of Paris. The statues that ornament the two jambs of that portal are surmounted by a series of canopies entirely alike, that form above the heads of those statues a shelter in a style not common. The sculpture of the portal of the Virgin further is impressed by an original character, and we know nothing of that epoch (1215 to 1220), that can be compared in grandeur of composition and beauty of execution. Here (4) is how those canopies are arranged to form a sort of entablature above the capitals of the little columns placed behind the statues, not confounded in the capitals themselves, as practised elsewhere.

The religious monuments of Burgundy have nearly all been d despoiled of their external statues. In that province the revolution of the last (18 th) century mutilated churches with more fury than in Ile-de-France and the provinces of the West. Casting down statues, the rage of the iconoclasts did not respect what accompanied them, and the sculptures of the portals were not only broken, but were cut away to the wall, as may be seen at Semur, Beaune, Notre Dame of Dijon. The few canopies that remain in that province from the beginning of the 13 th century cause regret, that they have been destroyed almost everywhere, for those rare examples are admirably composed a and sculptured. This may be judged by the example here given, (5), which came from the portal of the little church of S. Pere-sous-Vezelay. This canopy was painted like all the sculpture of the portal. The statue was placed against the little column A, whose capital is intersected by the canopy.

Already at that epoch Burgundian canopies are surmounted by little shrines in the form of a pyramid or tower, set on the course engaged in the structure. That superfluity is only found later on the edifices of Ile-de-France and Champagne.

About the middle of the 13 th century, at the moment when architecture became more delicate and the ornamentation finer, canopies are frequently covered by an extreme richness of sculpture, then there are little castles crowned by towers with battlements and their keep. In the interior of S. Chapelle of Paris, above the twelve apostles attached to the piers, are seen canopies with battlements, whose turrets are pierced by windows filled with blue or red glass. But the most remarkable

canopies of that kind that we know, exist above the figures of the north portal of the cathedral of Bordeaux (6).[1] Wntil that epoch as we have just stated, the canopies of the same arrangement of the dajacent statues are varied in form and dimensions; but from the middle of the 13 th century the canopies of the same series of figures are habitually similar and form a series of uniform arcades, as may be seen on the western portal of the cathedral of Rheims (7), yet they are not again or crowned by high pyramids, unless in Burgundy, where were already seen at the middle of the 13 th century some canopies terminating in the form of pinnacles or turrets. During the 14 th centsry canopies assume much importance, are covered by details, and are cut in the form of littel vaults very c carefully wrought, sometimes in the jambs of portals, beneath porches, they represent a separated small arcade supported at certain distances by slender piers, between which are set the figures. Pinnacles so arranged are to be seen under the unfinished western porch of church S. Urbain of Troyes (8), and beneath the porch of Semur in Auxois. Then instead of placing them on corbels, the statues stand on a continuous projection A receiving the little piers A, Fig. 8; thus they are sheltered beneath a deep gallery, can assume varied movements, touch each o her, form a part of the same scene, like the adoration of the Magi, the presentation at the temple, the baptism of Jesus Christ, etc. That novel arrangement lent itself to the dramatic sentiment, already sought by statuary at that epoch.

Note 1.p.4. That portal is now engaged in a sacristy, all the sculpture is very beaut ful; the statues of the twelve o opostles have been removed from that portal and deposited in the cathedral a short time since.

Above isolated statues, either placed in the interior or on the exterior of edifices in the 14 th century, canopies are generally surmounted by rich open pyramids, that present nothing particular, and resemble all the the terminations of the turrets of that time. (Art. Pinacle).

Without notably changing the forms of these canopies of the 14 th century, the 15 th century only exaggerated them; canopies are still seen in the architecture of the 16 th century over the figures; they are sculptured to excess, covered by

infinite details; such are these of the portal of the cathedral of Tours, those of church S. Michel of Dijon. It seems useless to give examples of these last details, which are in the hands of everyone. The wooden choir stalls of churches were s surmounted by canopies, that protected the religious from cold. These canopies are of great importance as a work of joinery. (Art. Stalle). Sometimes seated statues of Christ or of the holy Virgin dependant on reredoses, or are placed in the tympanums of portals or even of gables of churches, are sculptured under a canopy supported by columns, arranged like an altar c canopy. This sort of crowning accompanying the sacred figures merits the entire attention of artists, for then furnish examples of those internal decorations of sanctuaries, now destroyed in France without exception. A very curious reredos from the beginning of the 12 th century, and that was some years since the subject of a suit between the State and the board of a manufactory, that had sold this article to a dealer in curiosities (suit gained by the State, at the end of which t the relief was replaced in the church of Sarrieres-S-Denis n near Paris), and which is composed of three subjects; an annunciation, a baptism of Jesus Christ, and at the middle a seated figure of the Virgin holding the Child on her knees. The Virgin is surmounted by a canopy representing the celestial Jerusalem supported on two columns.(9). At the cathedral of Chartres, in the tympanum of the royal portal is to be seen t the Virgin in the same attitude, surmounted by a canopy. At the cathedral of Paris, the portal of S. Anne presents at the summit of its tympanum a magnificent canopy protecting the s seated statue of the mother of God. Art. Arche d'Alliance in this Dictionary gives a drawing of the canopy placed over the statue attached to the pier of the portal of the Virgin. (Same edifice).

DALLAGE. Pavement. Floor.

From all times in all countries have been employed to cover the areas of great floors, either in public edifices or in p private habitations, flat stones, polished and jointed, hard, without order or symmetry. Most limestone quarries possess in their upper layers a compact texture, suitable for this kind of paving. The Romans employed for pavements precious materials,

such as marble, porphyry, granite, evey jasper, and that with singular prodigality. There still exist some of these pavements, which are noted for the grand and simple arrangement of the design and the beauty of the materials employed; such are the pavements of the Pantheon of Rome, of the basilica of the forum of Trajan. The architects of the middle ages did not p possess these precious materials, like the Renaissance, and h had they possessed them, they no longer had facilities for c cutting them in large slabs and for polishing them. When they wished to decorate the areas of edifices, they then adopted the simplest and least expensive methods. From the Byzantine epoch the Greeks had endeavored to decorate the plane surfaces of therr monuments, vertical or horizontal, by means of inserts of colored marbles or inlays of colored cements in the slabs of white marble or limestone. Thus were obtained designs of great richness, very varied and refined, with materials easily procured; this was merely an affair of workmanshif. Th These procedures were employed in France from the 12 th century, and perhaps even before that epoch, although examples a are absolutely wanting for us. Gregory of Tours speaks of pavements of churches of great magnificence; but it is to be believed that those pavements were made according to the antique processes, and perhaps even with the remains of Roman monuments, or were composed of rude mosaics, such as one finds s still in such great number over the surface of France. (Art. Mosaique).

During the middle ages in France mosaic was but very rarely employed, and this sort of pavement composed of small pieces of hard stone forming interlacings, and known under the name of opus Alexandrinum, so common in Italy and Sicily, is found but exceptionally; then it is evidently imported from Italy. Such pavements are seen in the sanctuary of the abbey church of Westminster in London, and in that of S. Benoit-sur-Loire. That importation was not imitated by our clerical or lay architects. Then adopted by preference pavements of hard limestone, and when they desired to decorate these, they engraved d designs on their surfaces, which they filled with lead or cements, gold, black, green, red, brown, light or dark blue. Two causes contributed to destroy these pavements; first the frequent passage of the believers over their surfaces by their s

shoes, then the custom generally adopted from the 13 th century of interring clerics and even laymen beneath the pavements of churches. Thus many old pavements were removed to give place to tombstones, which in their turn formed a rich ornamentation obtained by the same processes of engraving and inlaying. (Art. Tombes).

The most ancient fragments of engraved pavements possessed by us came from the church of S. Menoux near Moulins. These fragments (1, 1 bis) date from the 12 th century; they are of white stone inlaid with resinous black cement. The piece of pavement (Fig. 1) forms the ground; that of (Fig. 1 bis) is t the border.

The numerous fragments of engraved and inliad pavements still to be seen in the old cathedral of S. Omer, and which were published by M. E. Wallet,[1] present us with the most complete s specimen of this sort of work, and which formerly decorated t the areas of choirs and apsidal chapels of the principal churches of France. These fragments evidently belong to different epochs;[1] now displaced, they originally formed a part of the pavements of the choir and of several chapels, and were not executed at the same time. Conformably to the method employed in the sculpture of the middle ages, each slab with some exceptions was covered by a complete design, and the entirety of the composition was obtained by means of placing these slabs adjacent. Thus the pavement was dressed and finished in the workshop before setting. Designs are very varied, several of these slabs belong to the end of the first half of the 13 th century, and represent warriors on horses, only covered by the shield and holding a pennon with their arms. Some inscriptions are read around the figures, and indicate that this pavement was made by means of gifts, each slab having been given by the personage represented.

Note 1.p.10. Desc. du pave. d.l.anc.cath. d.S. Omer,1847.

Note 1.p.11. M. Vitet in a report to the minister of the interior (1830), regards these slabs as belonging to the end of the 12 th century. M. Hermond does not believe them earlier than 12?0. The fact is that they do not all belong to the same epoch; some of these slabs have all the characteristics of the drawing of the beginning of the 13 th century; others are more recent.

Here (2) is one of those engraved stones, around which is r read this inscription:--"+ Egidius, son of Fulco of S. Aldegunde gave this stone in honor of the blessed Audomari."

The ground is brown as well as the inscription, and the lines of the figure and horse are red. Other slabs of stone result from the same decoration, composed of a combination of squares, representing grotesque figurer, ornaments, persons seated on a throne. A series of slabs of smaller dimensions, and which appear to belong to the beginning of the 13 th century, represent the liberal arts, a zodiac with the labors of the year.[1] A third numberous series of little squares of stone contains a considerable number of fanciful animals and ornaments of beautiful character, whose drawing dates at the end of the 12 th century or beginning of the 13 th. M. E. Wallet[2] has attempted to restore the entore composition of these slabs, and he separates them by means of bands made of little squares of black marble. We do not think that this restoration can be accepted, first because in the engraved slabs of which we possess still existing entireties, like those of S. Vicaise of Rheims, S. Denis, and of Canterbury, nothing is found to justify that hypothesis; then because in execution the contrast of these plain bands with those delicate designs produces the worst effect, as we have even recognized. The plain bands of black or dark red combine perfectly with tiles of glazed terra cotta (Art. Carrelage), whose tones are vivid and brilliant, and which are of the same material as these bands; but that harmony cannot exist between stones whose fine engravings are filled with colored cements and squares of black marble, whose appearance is always hard and cold. The bands of black marble absolutely destroy the effect of the engravings. In the lack of a great number of existing monuments, we possess drawings of the late Percier in the abbey of S. Denis, these drawings give a number of pavements composed of engraved stones, and in none of those pavements presents bands or enclosures of colored stones; on the contrary it is certain that the architects desired to obtain in their pavements that tranquil harmony of engravings, which suits so well a horizontal surface made for walking on. It is displeasing to place the feet on a pavement, whose violent tones suggest projections and hollows. The artists of the 12 th and 13 th centuries had sufficient instinct

in the effects of color in edifices to carefully avoid these defects.

Note 1.p.14. In the cathedral of Canterbury is still seen the zodiac thus engraved on the slabs of the choir, which dates from the 13 th century.

Note 2.p.14. Plate VIII.

The engraved slabs that decorate the areas of several apsidal chapels of the abbey church of S. Denis in France were very beautiful. They still exist in part, and have been restored to their old position, or are reproduced in the Album of the late Percier.

We give here (3) a part of the pavement of the chapel of S. Osmane. The step of the latar, a portion of which our plate shows at A, represents four virtues with a border of very delicate ornaments composed of quatrefoils containing fanciful animals. Around that step and raised 5.5 ins. above the pavement of the chapel are developed in the circular medallions s subjects representing the labors and pleasures of the 12 months of the year. (Art. Zodiaque). That border is relieved by black grounds, and is detached from a simpler ground composed of large quatrefoils with rosettes, between which are engraved symbolical animals, hunting slenes mingled with foliage. A narrow border B encloses the entire composition. One will note how delicate is the ornamental appearance of this rich pavement, without being confused, the artist took care to make the ornaments on the step of the altar on a scale much smaller than that of the ground of the pavement, so as to give that raised step something particularly precious. The general design is understood at a distance, and near by it attracts the eyes by the graceful combination of the engravings, that are all filled with black cement. Sometimes, as in the chapel of S. Peregrine of the same church, the pavement is composed of a uniform design enclosed by a border or an inscription (4). This pavement of which we give here a fragment at 1/4 scale is likewise of lias. The ground of the fleur-de-lis is black, that of the rosettes is olive green, the rosettes are red as well as the inscription, little cubes of gilded glass inlaid at A prevent the entire decoration from appearing a little dark.

Note 1.p.16. Those glass cubes are made like those found in all Italian mosaics of the 13 th century (called Byzantine).

i.e., the gold leaf is laid on a paste and is protected by a covering of very thin glass.

The drawings of the pavements of S. Denis have great purity; the figuers are traced by the hand of a master and in a remarkable style. All these pavements belong to the restorations o ordered by S. Louis in the old abbey church, i.e., they date from the middle of the 13 th century. The engravings are,made in the very hard lias, sunk about 3/16 inch and filled with cements, black, red, dark green, light blue and brown. In places are inserted pieces of colored or greenish white glass, p painted and gilded beneath to fix this, or also little cubes of gilded paste as in the preceding Fig. Some of these beautiful pavements have been repaired and replaced; their effect is that produced by a rug of very soft and harmonious tones.

There still exist in the church of S. Remy of Rheims a portion of the pavement, that formerly covered the area of the choir of S. Nicaise of the same city. This pavement dates from the first years of the 14 th century, and represents scenes from the Old Testament inscribed in square compartments (5). Each slab bears a subject, and that we have chosen represents Moses, Aaron and Hur, during the battle fought by Israel against Amalek.[1] The incised lines are there filled with lead without any coloring. It is unnecessary to say, that this sort of pavement costs very dear, and that they could only be placed in rich churches, in sanctuaries of some privileged chapels. Men were frequently satisfied with uniform pavements or those composed of black and white squares. That the designs are varied, but the squares are at the scale of the monument and g generally of small dimensions.

Note 1.p.18. S. Remy de Rheims, dalles du XIII siecle, pub. by M. Tarbe. Rheims. 1847.

The cathedral of Amiens still retains nearly all its pavement of the 13 th century, which only consists of small blocks 1.05 ft. square, black and white, forming a different design in each bay. Here (6) is one of these combinations. To judge of the effect of this pavement, now very much deteriorated, it is necessary to ascend the galleries and to observe it a from above at that distance; the compartments are very happily combined; in the nave they were interrupted by a great labyrinth also formed of black and white squares. (Art. Labyrinthe).

These pavements of an early date are not very common. Remains from a more recent epoch are found in many little churches too poor to have rplaced those old pavements. The church of Orbais possesses a pavement of the 15 th century (7) composed of little squares of black marble 5.5 ins on side and oblong white slabs set so as to represent a sort of matting with good effect. These designs, however simple they may be, are never vulgar. Pavements were employed not only in public edifices, but also in private habitations. Most of the great halls of castles, palaces of bishops and city halls were paved with g great slabs of hard stone. Frequently even in castles, these pavements were decorated by inlays of colored stones or cements, or even the stones alternated with painted stucco. In an account of the construction of the castle of Bellver in the island of Majorca,[1] there is a question of the pavements of t that feudal habitation, "made of stucco composed of live lime, plaster and great stones mixed with color; the whole so well polished, than one could believe these surfaces to be made of marble or porphyry." The ancients had understood the importance of pavements as a means of decorating interiors of edifices, and the middle ages only followed and perpetuated that tradition. Indeed we may say, that it was necessary to have lost the sense of decoration, to allow in an interior decorated by sculptures, paintings and colored glass, gray pavements of uniform tone, which by the extended surface occupied, assumed a value such that all ornamentation of the walls however rich was destroyed, or at least chilled, Colored pavements are one of the most splendid and pleasing decorations, that one could imagine. In France as in Italy, the middle ages did not fail to employ this sort of decoration, now too rarely applied.[1]

Note 1.p.19. This account begins on April 1, 1309, and ends at the end of December, of the same year. Melang.geog.et hist. of Jovellinos, edit. of 1845. Vol. 3. Madrid.

Note 1.p.20. It is only since the last (th) century, that has ceased to be employed colored pavements in edifices; and again under Louis XIV were executed magnificent pavements; we shall cite among others those of the great chapel of Fontainebleau, and of the choir of the cathedral of Paris, the last is a masterpiece. It is restored and replaced.

DALLAGE EMPLOYE COMME COUVERTURE.

Stone Slabs for Roofs.

When men had the idea of replacing the carpentry covering of halls and aesles by vaults, they thought to protect the extrados of these vaults by stone slabs or large tiles set in mortar; this system of covering also perfectly was perfectly applicable to tunnel vaults, semicircular or composed of pointed arches. In south France, Provence, on the banks of the Rhone and in the Centre, are still seen churches with vaults covered thus by superposed tiles (8). But one recognizes soon, that however well executed were these roofs, and however good were the stones employed, yet those stones by capilarrity absorbed a great quantity of water, and maintained a permanent dampness on the vaults; one also recognized that from the moment that the slabs were isolated from the extrados, the effect of capilarrity ceased, or at least dampness was no longer communicated to the vaults. Thus men thought about the beginning of the 13 th century, of placing the stone slabs on arches above the vaults, so as to allow the air to circulate between the underside of the slabs and the extrados of the vaults, and to combine these slabs so as to avoid uncovered joints as much as possible. constructors also recognized that the slabs having quite a small slope, it was necessary to hasten the flow of rainwater over their surfaces to avoid deterioration of the stone, on which the raiu did not flow rapidly. Consequently they took care to cut the external surface of the s slabs in hollowed form (9). By this means the water collected at the middle of each slab found a sufficient volume to produce a rapid flow, even during the fine rains, that more than t torrents penetrate and destroy limestone. Yet the joints of t this sort of slabs were not sufficiently raised to not be soaked during a shower; they soon gave a decided profile to the edges of the slabs, so as to raise the joint entirely, and no longer expose it except to drops of water falling directly fr from the sky. Thus are executed the stone terraces of the cathedral of Paris, set on arches and completely isolated from the vaults (10). Those great slabs are still slightly hollowed with a channel along their middle, so as to hasten the discharge of the water by forming little streams at these middles. Besides, the lap A of each slab is cut with a drip as indicated

by the section A', to prevent the water wetting the edge from aslending the bed E by the effect of capilarrity or by a violent wind.

The stone roofs of the terraces of Notre Dame of Paris rest (as shown by our Fig. 10) on purlins B of hard stone supported on arches turned at certain distarces and according to the horizontal projeltion given by the arches of the vaults, so as not to multiply thrusts. At the upper and lower edge of t the slope, the slabs rest on t e gutter D and on a projecting course C inserted on the wall.

A workman entering beneath these stone roofs by means of t traps arranged for that purpose and pierced as indicated by the sketch G, could examine the vaults, repair them, even rebuild them under cover, assure himself of the condition of t the joints of the slabs, remove and replace them easily if they deteriorated. Certainly the external appearance of the architecture demands from the architect an assured taste, a perfect knouledge of the resources of his art; but this care applied in the combination of the parts of the construction, which substantially contributes to the preservation of edifices and their easy maintenance cannot be too much recommended, for it is by this attention to the least details that one recognizes the true master of works, whose mind both comprises the general conception and the intimate organization of the e edifice, which he constructs. In that respect it must again be confessed, that we have much to learn from these unknown artists of past centuries.

One also finds examples of stone roofs with less simple combinations, but even more suitable to avoid maintenance, because no joint is uncovered. These roofs are combined nearly like the marble or terra cotta coverings of Grecian edifices in antiquity. light arches (11) are spaced to receive the rows of superposed slabs; on the rows of slabs serving as channels are placed other rows of slabs forming a complete covering, as s shown by the section A. In this sort of roof, there is no need anywhere of cement or mortar to caulk the joints, that are all covered. Thes sort of stone roof is found in the church of Chaumont and on the collegiate church od Poissy. These stone roofs are always dear, because they multiply the arches and require much cutting.

DALLES. (Art. Dallage). Tombstones. (Art. Tombeau).

DAMIER. Rows of Dentils.

This is an architectural ornament frequently employed during the 12 th century to decorate bands, archivolts and cornices of stone edifices; with billets and sawteeth (Arts. Billettes, Dents-de-Scie) it forms geometrical sinkings that break the monotony of horizontal or annular mouldings by spots of shadow very simply obtained without having recourse to sculpture. P Particularly in Ile-de-France, Soissonais and Normandy is found the use of these dentils dating from the end of the 11 th until the beginning of the 13 th centuries. The church of Notre Dame of Paris was crowned in its upper part by a beautiful cornice composed of 4 rows of dentils, three of which are still in place around the apse.

Here (1) at A is shown how these dentils are cut, each series being made in a course 9.8 ins. high.

Sometimes two rows of dentils are cut in a single course B. Then they ornament the upper slab of the cornice, a band or an archivolt. They also in Normandy cover the surfaces of walls, of the inclined surfaces of buttresses; then they represent wooden tiles. This was a rather expensive means of giving richness to tympanums and to the surfaces of walls, whose appearance seemed too cold.

DAUPHIN. Spout. Outlet. Dolphin.

Bottom opening of a leader recurved to cast water into a channel stone. From the 13 th century leaders of lead were employed; (Arts. Conduite, Construction), we know none taking the form that gave this name (Dolphin) before the 16 th century. One may yet see a spout in cast iron of that epoch attached to the base of a house located opposite the royal portal of the cathedral of Chartres. Fig. 1. gives a sketch of it. When leaders were attached to edifices in the 13 th and 14 th centuries, these spouts (i.e., the bottom openings of these pipes) are composed of a stone hollowed out to turn the water into the channel to receive it.

DECORATION. Ornamentation. Decoration.

There are in architecture two species of decoration, the d

decoration fixed on the edifices, and the occasional decoration attached on the occasion of certain solemnities. The fixed ornamentation during the middle ages belonging to the construction, it is unnecessary to devote to it here a special Article, and we refer our readers to all those Articles treating the parts of edifices capable of being ornamented, particularly the Arts. Sculpture and Statuaire. As for temporary ornamentation, it was applied in all times. The ancients decorated their temples with flowers, foliage and tapestries on certain occasions, and in that the Christians only followed their example. It only appears that during the middle ages, that within the churches were used temporary decorations, which could change the arrangement of the apparent form of those edifices. There were hangings attached to the piers or walls, garlands of leaves, heraldic shields, also sometimes scaffolds covered by tapestry intended to receive certain personages, and particularly exhibitions of objects forming rich treasures of abbeys and cathedrals. There may be found in Dictionnaire du M Mobilier details of this sort of decorations. What should be observed in temporary decorations formerly employed is the care applied by the decorators in the selection of the scale of the ornaments. These are always in proportion to the monument to which they are applied. Most of our modern temporary decorations, because of the neglect of this essential rule, destroy the effect that an edifice should produce instead of increasing it.

DELIT. On edge. (Art. Lit).

DENT-DE-SCIE. Sawtooth. Chevron.

A term employed to denote a species of ornament, that is s seen to originate in the 11 th century, and that was much used during the 12 th century, especially in the provinces of Ile-de-France, Normandy and the West. Sawteeth particularly serve to decorate bands, cornices and archivolts. The oldest are u usually wide, form right angles, and have small relief. (1). They soon become closes and acute (2), are strongly detached from the ground parallel to their face A, or from the leveled ground B. Toward the end of the 12 th century, the reentrant and projecting angles are truncated like D. Sometimes when t the sawteeth of that epoch are of small dimensions, particul-

particularly in the monuments of the West, they are again cut with right angles G. doubled sawteeth are cut as indicated in Fig. 3, so as to present a row of points passing over the others. On archivolts several rows of sawteeth are superposed, alternating and forming the projections indicated at E.

According to the method employed by the architects of the middle ages, each row of sawteeth was cut in the height of o one course, the vertical joints falling in the recesses. As t these ornaments were cut before setting, and the stonecutters desired to lose no stone, it resulted that the sawteeth in t the same course were often unequal in width, sence it was always necessary to comprise a certain number of complete teeth in one stone, whatever its length. But these irregularities do not seem to have disturbed the architects; yet it must be said, that they are much more pronounced in edifices built with parsimony, like village churches, for example, than in important monuments. Sawteeth indeed belong to the middle ages; nothing in Roman edifices could give the idea of this ornament, which gives so much vivacity to mouldings, and that makes the nude parts of the architecture of so much value. (Arts. Batons Rompus, Zigzags).

DEVIS. Design with Specification and Estimate.

In the 14 th century this name was applied to a graphical o project accompanied by a written description indicating the works to be done [1] and the estimate for the works.

Note 1.p.28. "William de Longueil, Viscount of Auge, to the sergeant of the sergeantry of Pont-l'Evesque, we commend that the work of masonry suitable to be done to the bridge, mentioned in the specification, you will cause to be cried for the customary lowest bid at all the places in your sergeantry, w where such cries are accustomed to be made. The year 1343. Marche, coll. Millin.

The design being made, men proceeded to contract by rebates, nearly as practised in our days, except that to compete for t the contract, it was necessary to belong to the trade guild, and that it did not suffice to present one's self to the competent authorities with a certificate frequently given by favor. Estimates were made in a lump sum or in detail, if made in a lump sum, it was stated at the end of the description of

the description of the works to be executed, that these works amounted to so much; if detailed, each article of the works was followed by a price. The series of prices attached to the papers was not then in use, and the contracts were with actual forfeits. Our departmental archives still contain a great number of this sort of contracts. We do not know whether in the 13 th century the master of the works made out the general d design, specifications and estimate for all that was required of him; what is certain is that during the 14 th and 15 th c centuries, each chief of the guild was often called to make a specification and estimate for the portion of the work concerning him. These being made, he bid for the work with a forfeit; but then there was no award, i.e., no competition between men of the same trade.

Note 1.p.28. Williams Co.

DIABLE. Devil. Demon.

A fallen angel, personification of evil. In the first monuments of the middle ages are found no representations of the devil, and we cannot state at what precise epoch sculpturs a and painters commenced to represent the demon in reliefs and paintings. Greek manuscripts of the 7 th and 8 th centuries, that represent the resurrection show the dead returning to life; but the painters only representing celestial spirits, the devil is absent from the scene. A Latin Bible of the 9 th or 10 th century,[1] ornamented by numerous line vignettes, shows us Job seated on the ruins of his house; the evil angel is speaking to him; he has a halo and is furnished with wings; in his left hand he holds a perfume-burner filled with fire; the toes of his feet have claws; this is one of the oldest representations of the devil known to us. Here the demon retains certain attributes of his primary power. In sculpture of the 11 th century in France the devil begins to play an important part; he appears on capitals of tympanums, he is found in all the scenes of the Old and New Testaments, as well as all the legends of the saints. Then the imagination of artists was pleased to give him the strangest and most hideous figures; s sometimes he presents himself under the form of a human monster, often with wings and tail, sometimes under the form of fanciful animals.

Note 1.p.29. Imperial Library. Manuscripts $\frac{b}{2}$.

The capitals of the church of Vezelay date from the end of the 11 th century, are filled with these representations of the spirit of evil. Here is one of them, that represents the proud rich man, torn from his palace by three demons; (2); this is one of the numerous visions of S. Anthony, that the sculptur has represented.

In Art. Chapiteau we have given a representation of the demon cast out of the golden calf by Moses, taken from the same church; it is one of the most energetic figures of that epoch known to us. In these primitive figures the devil acts or counsels; when he acts he takes the form of a man more or less deformed, provided with wings and sometimes with a tain ending in a serpent's head, his members being thin and fleshless, his hands and feet large, his hair ruffled, his mouth enormous and his body nude; when he counsels he takes the form of a fanciful animal, siren, dragon, serpent, toad, basilisk (b (bird with serpent's tail), a dog with human head. Already in the 12 th century, the authors of animal books strove to make real or imaginary animals, figures symbolical of the virtues or vices (Art. Bestiare); then in sculptures or paintings, w when one desired to represent a personage under the influence of a bad passion, he was accompanied by one of these animals, a symbol of that bad passion. In the mediaeval museum of the city of Avignon, we see a fragment of a capital of white marble from the 12 th century, representing Job reproached by his wife and his friends; beside Eliut, one of the friends of Job is a siren that seems to advise him (3). Now the siren during the middle ages is the symbol of falsity and deception. On th the portals of the churches of that epoch the vices are sometimes personified (Art. Vice), and the persons representing t the vices are accompanied by devils, who take pleasure in tormenting them. The devils also appear in parables or legends, as in the parable of the bad rich man, for example, and in t the legends of S. Anthony and S. Benedict, who according to the legends had very frequent relations with the devil. It wo would be useless to copy here the numerous examples of these monstrous figures; we shall content ourselves with indicating the characters given to the representations of the devil during the various periods of the middle ages. During the Romanesque period, the devil is a being that sculpturs or painters

endeavor to make terrible, frightful, who plays the part of a power with whom it is permitted to taka liberties. With the western sculptors of the 13 th century, laymen far advanced as artists, the Gaulish spirit begins to appear. The devil assumes a less terrible character; ; he is often ridiculous, his character is more depraved than frightful, his countenance is ironical rather than savage or cruel; sometimes he deceives, frequently he is duped. The scene of the weighing of souls, which occupies the principal place in the drama of the last judgment, shows us the devil that endeavors to incline one of the scales of the balance to his side, with very little loyalty. The demons that accompany the damned seem to rail at the troop of unfortanates dragged into hell; some of there subalterns in the asmy of the shades sometimes even have an air of brutal good humor, that can make one believe in a reconciliation. Yet the entirety of the infernal scenes sculptured at t the beginning of the 13 th centuryalways has a dramatic appearance designed to move. At the central portal of the cathedral of Paris, for example, the entire side occupied by the demons and the souls left to them on the left of Christ, is scluptured by a master's hand; some episodes are rendered in a moving fashion.(Art. Jugement Dernier). Among the voussoirs covered by demons and the damned seems enthroned a superior devil; he is crowned (4). His body is surrounded by a serpent; he is s seated on a group of personages, among whom are seen a bishop and a king. This sovereign devil is fat, thick lipped; he has enlarged breasts and seems to repose in his triumphs. Beside him are represented scenes of disorder, confusion and despair, rendered with energy and talent in execution truly remarkable. The painters and sculpturs of the middle ages have adopted a trinity of evil in opposition to the divine Trinity. (Art. T Trinite). From the end of the 13 th century the devil loses much of his ferocious character in sculpture and painting; he is relegated to the lowest rank, he is scoffed at and frequently has the countenance of this part; in many legends remade at this epoch, he is the dupe of pious frauds, like the celebrated legend of the monk Theophilus and that of the smith Biscornet, who is said to have made the ironwork of the doors of the cathedral of Paris. This smith lived in the 14 th century, and was charged with making the ironwork of the three principal

portals of Notre Dame.[1] Desiring to make a masterpiece, and f finding it very difficult to know how to proceed in this, he gave himself to the devil, who appeared to him and proposed to forge the ironwork on one condition, well understood, that Biscornet by written contract in regular form should deliver his soul to the spirits of darkness. The contract is signed, the devil sets himself to work and finishes the ironwork. Biscornet, aided by his infernal helper, sets the ironwork on t the two side portals; but when he tries to iron the middle p portal, the affair becomes impossible, because the central do doorway serves for the passage of the holy sacrement. The devil had not thought of that difficulty; but the contract not having been entirely fulfilled by one of the parties, Biscornet became again possessor of his soul, and the devil lost h his ironwork of the two portals.

Toward the end of the middle ages the devil is seen to have grown old, and no longer carries on his affairs. The plastic arts of that epoch only reproduce the spirit of the popular legends, whose last traces we have followed on the puppet theatre, where in spite of his tricks and craftiness, the devil is always thrashed by Punch.

The great devil sculptured on the tympanum of the portal of the cathedral of Autun in the 12 th century is a frightful b being, well calculated to shock fresh imaginations; but the imps sculptured on the reliefs of the 15 th century are rather comic than terrible, and it is evident that the artists, w who carved them, cared very little for the wicked tricks of the spirit of evil.

Note 1.p.33. This ironwork dates from the end of the 12 th or the first years of the 13 th century, and the story of the smith-Biscornet is a popular legend; it merely indicates the tendency of minds in the 14 th century to only see in the devil a fallen power, easily overcome with a little skill.

DIEU. God.

The middle ages represent God by his works in religious m monuments; he was only represented in the scenes of the Old Testament, in the creation, when speaking to Adam, Cain, Noah, when he appeared to Moses. In the new law Christ alone represents divinity. If there exist images of God the Father, they

are found with the Son and the Holy Spirit.(Art. Trinite). Only in the epoch of the Renaissance did artists, sculptors or painters introduce God the Father in the scenes, that they depicted.[1] Yet one sometimes sees on the tympanums of portals of the 13 th, 14 th and 15 th centuries, representations of C Christ in his glory, on the day of judgment, God the Father as a bust and blessing; he has a cruciform halo, wears a long b beard, and his hair falls on his shoulders. At the end of the 15 th century, God the Father is generally covered by the tiara with triple crown, like a Pope. We do not know of a single statue of the 13 th and 14 th centuries representing God the Father; the sole divine personage taking a principal place in religious edifices is the Christ man or the Christ triumphant. (Art. Christ). The Virgin Mary and her Son both occupy the imaginations and the hands of artists. (Art. Vierge Sainte). It seems as if God had delegated to them his entire power over created beings.

Note 1.p.34. See Iconographie chretienne, by M. Didron. Improv. 1843. We refer our readers to that excellent work.

DOME. Dome.

Employed for cupola (improperly ?). Duomo in Italian means a cathedral or episcopal church; since many churches of Italy are surmounted by one or more domes, the part has been taken for the whole; men speak of the dome of the Invalides, of the dome of the Pantheon; they should say cupola of the invalides or of the Pantheon. (Not according to American usage).(Art. Coupole). Il duomi di Parigi, for an Italian is the church of Notre Dame of Paris, which as all know, is not surmounted by a dome.

DONJON.[2] Keep. Donjon.

Note 2.p.34. Dongier or doingier in old French means domination or power. (Old French poem).

The keep essentially belongs to feudalism; it is not the Roman castle, and is not the retreat, the last defense of the citadel of the first times of the middle ages. The keep commands the defenses of the castle, but it also commands the surroundings and is independent of the enclosure of the fortress of the middle ages, in that it has a separate exit to the co-

country. That essentially characterizes the keep and distinguishes it from a tower. There is no feudal castle without a k keep, as there was formerly no strong city without a citadel. Every good citadel must command the city and still remain independent in its defense..

In the middle ages it was the same with the caStle, and the keep was to the castle what this was to the city. The garrisons of the middle ages possessed one defense more than ours; driven from the city, they retired into the castle;:that being taken, they retired into the keep; the keep being pressed too closely, they could still risk the chance of escaping by a postern skilfully concealed, or pass through the enclosing lines at night by a bold stroke. But that arrangement of the keep belonging,to a feudal fortress was not alone made to resist or to escape from the enemy outside, it was the result of the feudal system. A lord, however peaceful, only held his power from his vassals. At the moment of peril, they must appear at the call of the lord, id necessary shut themselves within the castle and aid in its defense; but it occurred that the vassals were not always faithful under every test. Frequently the enemy won them over; then the betrayed lord had no other refuge than his keep, within which he shut himself with his own men. It then remained to him as a last resource, either to d defend himself to extremity, to take his time to escape, or to surrender.

We have said elsewhere (Art. Chateau), that the system of the defense of places dureng feudalism was only a series of means accumulated by mistrust, not only of a declared enemy, but of the garrisons themselves. That is why the study if the fortresses of that epoch furnishes an Inexhaustible subject for interesting observations; mistrust sharpened the mind and made it find resources. Indeed if some castles present nearly similar arrangements, on the contrary keeps offer an infinite variety, both in the general conception and in the details of the defense. Since the lords at any moment might be at war w with each other, greatly preferred that if their neighbors a attacked them, that they should not find defenses arranged l like their own. Each aimed thus to defeat his enemy, sometimes a friend of the day before; thus when the lord received his equals in his castle, even if friends, he took care to l

lodge them in a special building, received them in the great hall, in the apartments of the ladies, but very rarely took them into the keep, that was closed and menacing in time of peace, while they gave each other evidences of friendship. I In time of peace the keep contained the treasures, arms and archives of the family, but the lord did not lodge there; he only retired there with his wife and children, when it was n necessary to call a garrison into the enclosure of the castle. Since he could not live there and defend himself singly, he then surrounded himself by a greater or lesses number of men at arms in his pay, who were shut up with him. From thence e exercising a minute oversight over the garrison and the outside (for the keep is always placed at the weakest point of the fortress), his faithful men and himself held it with regard to the vassals and their men crowded in the barracks" at any hour being able to make a sortie and retsrn by concealed and well guarded exits, the garrison were ignorant of the means of defense, and naturally the lord did everything to make them thought formidable. It is difficult to find a more beautiful programme for a military architect; thus the keeps among the edifices of the middle ages are frequentln masterpieces of foresight. We have found in these structures, little known or imperfectly studied, arrangements demanding careful examination, because they bring to light one of the sides of feudal life.[1]

Note 1.p.36. So far, men have scarcely occupied themselves in the archaeological world except with religious or civil a architecture; yet feudal architecture, of which the keep is the most striking expression, in our opinion is superior to all that the art of the constructor produced in the middle ages.

The first reason that caused the erection of keeps was the Norman invasion. The Merovingian villas must strongly resemble the Roman villas; but when the Normans threw themselves p periodically on the western continent, the nobles, monasteries, kings and cities themselves thought of protecting their domains by a sort of wooden blockhouse erected on the banks of r rivers and as much as possible on sites already defended by n nature. These fortresses into which at need were brought in haste all precious possessions, commanded entrenchments more or less extended, composed of a ridge crowned by a palisade

and protected by a ditch. The Normans themselves, when they had adopted the habit of landing on the coasts of Gaul and ascending rivers, established on some islands near their mouths, or on promontories, entrenched camps with a firtress, to protect their booty from attacks and their moored vessels. Thus in provinces especially ravaged by the Normans are found the oldest keeps, and these primitive fortresses ane usually built on a rectangular plan forming a parallelogram sometimes divided into two parts.

At many poents on the banks of the Seine, Loire, Eure, and on the coasts of the East and West, are found remains of these primitive keeps; but these structures were profoundly modified after the epoch in which they were erected, and only show substructures often incomplete. It appears that the first keeps, built of masonry according to a nearly uniform system, were built by the Normans when they were definitely established on the continent (Art. Chateau), one of the best preserved among these keeps is that of the castle of Arques near Dieppe, erected about 1040 by William, uncle of William the Bastard, In saying that the keep of Arques is one of the best preserved, it must not be pelieved that an edifice will be found there, whose arrangement is easily seized at first sight. The keep of Arques was repaired in the 12 th century, appropriated for use by artillery in the 16 th century, mutilated after the revolution by the inhabitants of the village, who carried away all that they could, and presents at first sight only a ruin ravaged by time and men. It is necessary to examine these ruins with the most scrupulous care, trace the numerous turns of the passages and the habitations, to return twenty times to the site, in order to appreciate the intelligent efforts shown by the constructors in the combination of that fortress, in our opinion one of the most remarkable.

Let us first say a word of the structure. As in most military edifices of the Romanesque epoch, the construction is here according to the Roman method, i.e., it is composed of a concrete consisting of flints set in a bed of very hard and coarse mortar, faced with small cut stones 5.5 to 7.9 ins. high between beds by 7.9 to 12.6 ins. long. This facing is of freshwater limestone from the valley of Sie, of good quality though quite soft, but hardening in the air.[1] We must ask the

entire attention of our readers to follow us in the following description, that we shall make as clear as possible.

Note 1.p.37. This quality of stone was already employed by the Romans, and it is found in the antique theatre of Lillebonne. Since the 13 th century it has ceased to be quarried, we do not know why.

Fig. 1 gives the plan of the ground story of the keep of Arques, which is located near the south gate of the castle.(Art. Chateau, Fig. 4.). At A is the entrance with its flying bridge, its double defense A in the form of an internal turn, with w wide machicolations commanding the gate A. A long bent corridor leads into the internal court. At C was a little guard w without direct communication with the interior of the keep, but included in its perimeters To enter the fortress it was necessary to turn to the left and reach the door D. That door passed, a stairs was found on the right with a second door E pierced through a buttress, then turning to the left a very long stairs E', direct and very steep. We shall return to this soon. Along the rampart of the castle at F, and masked externally by the battlemented gallery, one reached another very narrow door G, that admits ao a starrway containing a central stairs turning to the left, making a complete revolution and reaching the landing I, whence by a stair turning to the right in the thickness of the wall, one ascends to the second and third stories, as we shall see. The two lower halls J J had no direct communication with the exterior (the passage L having been opened in the 16 th century) and not communicating with each other. One must descend into these two lower halls by stairs or ladders passing through openings arranged in the floor of the second story. These halls were actual cellars suitable for containing provisions. At K is a well more than 263 ft. deep with masonry wall up to the floor of the third story. Do not omit to note the stairs M cut in the rock (chalk) and descending by a rapid inclination to the bottom of the external ditch. Let us also mention the stairs N, that passes over the entrance corridor B; its utility will soon be demonstrated.

Let us see the plan of the second storn (2). One can only r reach this story by the screw stairs O extended from this second story to the third, i.e., it was necessary to descend to the second story after having ascended to the third, or indeed

taking the stairs N (just mentioned) passing through the tower commanding the entrance B, ascending a step and turning to the right in the narrow passage with steps, one entered the a ande hall P, and from thence penetrated into one of the halls J′ of the second story of the keep. As for the hall J″, it was necessary to reach it by passing through a trapdoor arranged in the floor of the third story. All that is very complex; bu but yet this nothing more. Let us endeavor to remember these various exits, and not lose the trace of these stairs and corridors, an actual labyrinth.

Arriving at the third story (3). There again exists the unbroken partition wall, forbidding all communication between the two halls of the keep. Resume the great stairway E′, just abandoned; it reaches a landing on which at the left opens a door directly entering the hall J″″. But it is not necessary to believe it easy to ascend that long stairs; first on the right and left exist two walks on a level with the upper landing, that allowed the numerous defenders to crush the assailants ascending this long stairs; then several machicolations opened in the upper floor of that stairs dropped a rain of s stones, beams and boiling water on the assailants. From the hall with stairs with a full turn, that we have seen at the right in the plans of the ground a second stairs, by the bent stairs in the thickness of the wall, one reaches the corridor S, which by a door admits to the hall J″″. Hence if by surprise or otherwise an enemy succeeded in passing the stairs E′, the defenders could pass through the corridor S, steal away, descend by the stairs I (plan of ground story), leave by the door G, seek the postern M communicating with the ditch; or - again ascend by the stair N, the tower B (plan of second story), reenter the hall J′ by the ante hall P, take the screw stairs and join the portion of the garrison still occupying half the keep. On the contrary, if the assailants by sap or scaling (which was scarcely possible) took possession of the hall J′″ (plan of third story, Fig. 3), the defenders could s still steal away by leaving the ante hall P′ and descending the stairs T′ as we have seen, communicating either with the hall J′ of the second story, or with the stairs N. Or again the defenders could again ascend or descend the screw stairs O, passing through the cabinet V. From the landing T one des-

descended to the terrace U commended by slots pierced in the corridors S S′.

From all this it may be admitted already, that the garrison of the keep was double in two stories (second and third); that these two parts of the garrison had no direct communication w with each other, that to establish this communication, it wa s necessary to ascend to the fourth story occupied by the commander, and that consequently if one side of the keep were taken, the garrison could assemble in the upper part, resume the offensive, crush the assailants lost in the midst of the labyrinth of passages and stairs, to regain the portion already lost.

The fourth story (4) is entirely destroyed, and we can only have an idea of it by the drawings of 1708, reproduced in the work of M. Deville.[1] These drawings indicate machicolations that still existed at that time in the upper part, and the g general arrangement of that story, converted into a platform after the 15 th century to place artillery. M. Deville did n not seem to recognize the age of the vaults which still covered the third story in 1708. Yet sections of the ribs of those vaults (5) sufficiently show that they belong to the restorations of the end of the 15 th century. Primitively the stories of the keep, conformably to the Norman method, were only separated by wooden floors, traces of which are found on the internal surfaces. The plan of the platform given in the drawings of 1708 shows sufficiently that the partition wall no longer existed in the fourth story. Indeed from that story the command must be exercised and the defense be organized with unity.

Note 1.p.41. Hist. du chat. d'Arques. Rouen. 1839.

Then this plan (Fig. 4) indicates a single hall X with a c central post designed to relieve the upper carpentry; a cabinet Y, that might serve for a chamber for the commandant; the machicolations pierced in the chamber Z above the great flight of stairs; the two macricolationr a a reached by the two openings b b, the defensive passage c c, made in the thickness of the wall above the arches of these machicolations, and the machilocations at the angles d d. In this plan is also seen the defense of the gallery e, that commands the outside and allows one to see what passed in the ditch beside the gate. At f is a fireplace and an oven at h, for the keep contained a mill (probably for hands). On the arrangement of the upper

story we possess only very vague data, since in 1708 that story was destriyed; we only see in an account of repairs from 1355 to 1380,[1] that turrets covered with lead terminated that story; these turrets must be closed to shelter the defenders, such as still exist at the top of the keep of Chambois,[2]. T The plan of that story, that we give (6), indicates two turrets at l l′; the turret l′ showing its machicolations i over the flight of the grand stairs, further at m are perceived t the openings of other machicolations commanding the reentrants of the buttresses. This m′ opens on the lower flight of the great stairs, showing the simple uncovered guard wall, traced at D in the plan of the ground story. Fig. 1.

Note 1.p.42. Manuscript in Imp. Library.

Note 2.p.42. See this keep later. Fig. 1.

Fig. A presentr the facade of the keep of Arques next the c court. At A is the opening of the great corridor of the external gate. at B is the entrance of the stairs of the keep. The other parts of this Fig. explain themselves by examination of the plans.

Fig. 8 gives the section of the structure on the broken line A A, B B of the plans. At C is the little guard room traced at l on the plan of the ground story. at D is the screw stairs situated under the great flight whose landing is at E; at F is seen the machicolations commending the landing. Today the structure does not rise above the level G: in 1708 it existed to the level H, and the extrados of the vaults built in the 15 th century did not exceed this level: so that the walls b between G and H served as parapets and openings of embrasures for cannon. The guns leveled on that platform contributed , by firing on the duke of Manenne, to the success of the battle gained by Henry IV in the valley of Arques.

Fig. 9 traces the section of the keep on the line C C, D D of the plans. At A is detached from the principal body the buttress serving as a traverse to see the bottom of the ditch a and command it from the top of the keep. At B is cut the corridor at the level of the third story, which commands the defensive gallery D and the terrace Ga At C are visible the great machicolations with the upper defense in two stories made at the expense of the walls over the arches.

The section (10) made on the line E E, F F of the plan per-

permits the understanding of the ingenious combination of the stairs. At A is profiled the great flight reaching the third story with the upper machilocations, which command its last steps and landing. At R is seen one of the two side platforms arranged to receive the defenders of the stairs and to crush the assailants. At D appears the trace of the narrow inner s steps leading to the corridor S indicated on the plan of the third story, and which permits the defenders to disarm or to leave by the screw stairs B. At C is a false landing, that commands the turns of the stairs B.

The castle of Arques is admirably located, surrounded by w wide and deep ditches commanded by the keep of this importance, and must have been an impregnable place before artillery. Scarcely built, it was soon besieged by William the Conqueror, and was only taken by famine after a long blockade. Repaired and rebuilt in part by Henry I in 1123, it was besieged by Geoffrey Plantagenet, who could enter it only after the death of its commandant, William Lemoine, slain by an arrow, that siege lasted an entire year, 1145. Philip August invested the castle of Arques in 1202, and soon raised the siege on the news of the captivity of the young Arthur of Brittany, fallen into the hands of John Lackland. The keep of Arques was the last fortress to surrender to the king of France, after the conquest of Normandy from the hands of John Lackland. Henry I as we have said, caused the execution of considerable works at the castle of Arques; but the examination of the existing structures cannot cause it to be supposed, that the great work of the keep belongs to that epoch. Perhaps Henry restored the upper parts that no longer exist, perhaps even the great machicolations of the facade (Fig. 7) date from the reign of that prince, for the arches of the machicolations, that we see represented as round, are pointed arches on the drawing of 1708, also drawn incorrectly, because it does not indicate accurately the parts of the structure, that we have seeu still standing. As for the general arrangement, the system of corridors and stairs, with a little care one can perfectly recognize their traces, and in that keep of Arques, that was taken by storm, is a military structure of the highest interest, a and in spite of its ruinous state, is much more complete from the point of view of defense, than are the celebrated keeps

of Loches, Montrichard and Beaugency, constructed on nearly the same method. What especially makes the keep of Arques a complete type of its location in the plan of that castle; protected by the curtains of that place and two rivers, it still commands the exterior: it possesses its well defended gate for outside assestance; it protects the enclosure, but also can batter it successfully in case of need; it is absolutely not to be attacked by sap, the sole means then employed for overthrowing walls; it permits receiving and maintaining an uncertain garrison, for its defenders can only act blindly, and at the point assigned them. Treason or surprise would not be practicable, since if a part of the keep were taken, it would be eary for some determined men to cut the communications, to enclose the assailants and crush them before they could be recognized. As a last resource, the commandant and his devoted men could still escape. Fire alone could destroy the fortress; but when one considers the width of the ditches of the castle cut at the top of a hill, the height of the walls, the absence of external openings, it is not intelligible how an assailant could have have cast incendiary materials on the roofs, the more that it was difficult for him to establish at a suitable distance to cause his casting machines to act successfully.

The Norman keeps and the Romanesque keeps in general were built on a rectangular plan, a fortified habitation, the dwelling of the lord: they contained cellars for provisions, a chapel, halls with cabinet, and always at the top a great free area for easily organizing the defense. Most of these rectangular residences possessed their principal stairway separated from the body of the structure, and sometimes this partition wall dividing them into two equal parts. The entrance is habitually placed much above the ground at the level of the second story. One can enter the keep only by a ladder or by means of a movable bridge with a wooden stairs, that was destroyed in time of war.

The little keep of Chambois, that dates from the 12 th century, presen s most of these arrangements in detali. Its plan is rectangular with four square buttresses at the angles. A square tower placed at one side contained originally little closets and the wooden stairs crowned by a defense, and ascending only to the fourth storw. The defense at top was reached

by a screw stairs placed in one of the angle buttresses. The upper parts of the keep were rebuilt in the 14 th century, and according to the system of defense of that epoch; but from the first arrangement still remains three stories and an extremely curious defensive gallery. The plan of the keep of Chambois is given here by Fig. 11. One sees at A the square turret attached to the body of the structure, and in which in the 14 th c century was made a screw stairs. This keep was not vaulted, no more than most Norman keeps, the stories were separated by w wooden floors supported on internal corbels. Its doorway is r raised 19.7 ft. above the ground, and opens at the side of t the square turret containing the wooden stairs; one could reach that doorway, whose threshold is at the level of the floor of the second story, only by means of a ladder, and the keep was defended in its lower part only by the thickness of its walls. At the beginning of the 14 th century the old buttresses were replaced by a parapet with machicolations, battlements and s slots. On the four angle buttresses were beautiful turrets with battlements on the upper story, probably in the place o of the old flanking turrets.

Here (12) is the elevation of the keep of Chambois on the side of the little square tower before the construction of the buttresses of the 14 th century. The building of the 12 th century rises intact today to the level B; at the level C opens the postern. But the most singular peculiarity of the keep of Chambois consists in the upper defensive gallery, which below the buttress places the four turrets of the little attached tower in communication with each other, without its being necessary to pass into the central hall occupied by the commandant. Thus the defense was entirely independent of the habitation, and it occupied two storier, one covered and the other uncovered. Here in section (13) is the arrangement of this covered defensive gallery, that extends around the keep and connects the turrets below the buttresses. This defensive gallery still exists nearly complete. The keep is constructed of rubble connected by excellent mortar, the angle buttresses are built of small cut stones, as well as the enclosures of the openings.

Rectangular keeps like those of Arques, Loches, Beaugency, Domfront, Falaise, Broue, Nogent le-Retrou, Montrichard, Mont-

Montbazon, Chasvigny, Blanzac, Pouzanges, which were all erected under Norman influence during the 11 th and 12 th centuries, were rarely more than passive defenses, guarding themselves rather by their mass, by the thickness of their walls and the difficulty of access, than by defenses properly so called. These were excellent retreats, when it was only necessary to protect them against troops armed only with bows and crossbows, possessing some imperfect machines, and only being able to resort to sap as the last recourse. But if from the interiors of these residences men scorned assailants equipped with war machines of weak power, neither could they cause them serious losses. Besieged lords only had to watch over their men, make frequent rounds, assure themselves that the gates were closed, to cast some projectiles from the battlements if the assailants attempted to approach the walls, to countermine if they mined; and further they could remain thus for entire months w with nothing to fear, even before a great army. Thus it was almost always by famine that fortresses were taken. But when the art of attack was perfected after the first crusades, when besiegers placed powerful engines in battery, branched trenches were made, long covered wagons were employed, those cats, to allow sapping the walls without danger to the miners, then the rectangular keeps, however thick the walls, appeared insufficient; their angles were not flanked and offered salient points that the miner attacked without great danger; the garrisons shut up in these fortresses saw with difficulty what p passed outside, they could not attempt sorties by those doors placed several yards above the ground; the complication of d defenses was a cause of disorder at a pressing moment; the besieged themselves wandered or lost much time in the midst of those numerous bends, or were even caught in the snares placed by them selves. From the middle of the 12 th century, these defects of the defense of the Norman keep were certainly recognized, for the system was completely changed, and they abandoned at once the rectangular form. One of the first and happiest attempts toward a new system is seen at Etampes. The keep of the castle of Etampes, although very ruinous, still possesses more than three stories, and one can take account of various details of its defense. We cannot assign this structure a date before 1150 nor later than 1170. Some capitals s

that still exist and the mode of building belong to the last time of the Romanesque epoch, but still cannot date from the reign of Philip August. Tradition carries the construction of the keep of Etampes back to the beginning of the 11 th century, which is not admissible. Philip August shut up his wife Isburge in 1199 in the keep, that we still see today;[1] then it existed before that epoch. The capital drawn here (14) can leave no doubt concerning the date of that fortress; it is i indeed the sculpture of the beginning of the second half of the 12 th century.

Note 1.p.51. Dom Fleureou. See the note on the keep of Etampes inserted in Volume 12 of Bull. Mon. p.488 by M. Petit.

The plan of the keep of Etampes is a quatrefoil, which gives a better flanking than a cylindrical tower. It is placed at the end of a plateau dominating the city of Etampes, above the railway station. The defenses of the castle formerly extended far on the plateau toward the west and south; so on the western side this keep was protected by a guard wall, whose substructure is still visible. This wall (15) probably returned at the south, ending at a sort of diagonal road A' designed to receive the end of the drawbridge, that permitted entrance to the tower by a postern placed below the level of t the second story. The ground story was roughly vaulted with rubble, and these vaults rested on a great central column, t that extended to the second story. It was necessary to descend from the second story to the level of the ground story by a stairs B, made in the thickness of the wall, which is not less than 13.1 ft. At C is a well and at D the pit of the privy. F from the vestibule E of the postern, turning to the left, one then descended by the flight B to the lower story; turning to the right, one ascended by several steps to the level of the second story. Thus the vestibule E was placed at the middle of the story, so that the assailant entering abruptly by the postern and goint straight forward fell from a height of at least 13.1 ft. to the floor of the cellar, where he found himself shut up; the defenders posted on the stairs ascending on the right must further push him into that open pit. The right flight then reached the level of the second story (16) at G; from there one entered the hall through the opening of the window. But if one desired to ascend to the third story, it

was necessary to enter the little guard room H, placed just over the vestibule of the postern and pierced by a machicolation, take the stairs I leading to a screw stairs serving the third and upper stories; the landing at the level of the third story was placed over the point G. The curb of the well C was placed on the vaults of the ground story, then from the second story was drawn the water necessary for the needs of the garrison. At L is seen a privy. The second story was originally covered by a floor, whose principal beams rested on the central column, according to the dotted lines. About the middle of the 15 th century, this floor was replaced by vaults. The groin lines of these vaults, the corbels supporting them, and the manner in which they were inserted later in the structure, are certain signs of the restoration, that has modified the primitive arrangements of the keep of Etampes. The little guard room H placed over the postern, probably contained the mechanism intended to work the drawbridge ending on the road A′.

The third story (17) was designed for the residence of the lord. It is furnished with two fireplaces O and has privies at L. At G is seen the landing of the stairs in a window opening with floor placed a little below the main floor. Four engaged columns bear two great diagonal transverse arches, whose utility is at once recognized; further, two other traysverse arches are turned at P to bear the central roof. The screw s stairs continues anf reaches the level of the fourth story w with battlements and arranged for defense. The roof consists of a square hip roof intersected by conical roofs. Now assume (18) a section made on the line A B of the plans. We see at F the false internal entrance pierced at the level of the floor of the postern and falling into the cellar. at B′ is the flight descending to the floor of that cellar along the well; at G is the landing of the flight at the level of the second story; at H is the door opening into the guard room located over the vestibule of the postern and in the stairway, partly a s screw, whose first exit is seen at G at some steps below the floor of the third story. Continuing to ascend this screw stairs, one reaches the door M, pierced at the level of the floor of the fourth story, above the great hall, a story entirely intended for defense. But that the defenders could easily

receive the orders of the commandant living in the great hall, or to promptly inform him of what was passing outside, a sort of galleries had beem established at mid-height of that hall in the four lobes formed by the quatrefoil, galleries to which one descended by trap ladders passing through the floor of the fourth story as indicated by the plan of the upper part (19). That arrangement had also the advantage of allowing the entire garrison to gather in the great hall without crowding, and of promptly sending the defenders to the battlements. There are found in place today the fastenings of the principal beams of these four galleries, the corbels that received the anchors, the springings of the transverse diagonal arches and the arches parallel to the walls they supported; the upper openings are preserved for about half their height. The plan (Fig. 19) shows that the upper part was entirely free, only traversed by the walls resting on the two transverse arches marked P on the plan of the third story, walls pierced by openings and intended to support the central roof. The two great diagonal t transverse arches supported the floor and the kingpost of the roof. Indeed this floor, on which it was necessary to place in reserve a considerable store of projectiles, and that had to resist the movements of the defenders, must present great stability. It was they necessary for the beams to be relieved in their spans; the diagonal arches perfectly fulfilled that office. The upper story was pierced by numpeous openings, as indicated by a perspective engraved by Chastillon, and must be equipped with defensive galleries in time of siege, according to the defensive system of that epoch. These defensive galleries, shown in plan (Fig. 19), are found at S on one of the lobes of the tower in external elevation (20). That elevation is taken on the side of the postern. The upper structure above the level V of the layer exist today; but although this keep is very ruinous,[1] yet all its internal arrangements are perfectly visible, and explain themselves with a little a attention in their examination. The building is well done; t the jambs of the windows, arches, piers and angles ane of cut stone; the rest of the masonry is of rubble connected by excellent mortar. The keep of Etampes must have been a powerful defense for that epoch' also very habitable, if could contain a numerous garrison relatively to the area occupied.

Note 1. p.57. Known under the name of the Tower of Guinette.

The keeps are certainly of all military structures those e explaining most clearly the kind of life, customs and manners of the feudal nobles of the middle ages. The feudal lord retained something of the Frankish chief, he lived in his habitation in the midst of his companions in arms; but still one already perceives after the 12 th century, that he sought to isolate and separate himself and his family from his garrison; one feels mistrust everywhere within and without the fortress. At night the keys of the keep and even those of the castle were brought to the lord, who placed them under his pillow.[1] As we have seen and shall see, the actual keep was approached from outside; it even possessed secret exits independent of those of the castle, to escape or make sorties into the country; i its lower stories were well walled and intended for provisions; its intermediate stories contained a chapel and the habitation; its top served for defense; there is always found a well, fireplaces and even ovens. Besides, the keeps present very varied arrangements, and that variety indicates in particular the attention devoted by the nobles to the construction of such important a part of their castles. It is evident that each lord desired to embarras assailants by novel defensive combinations belonging to him alone. Dating from the 12 th century one notes a singular diversity in these fortified residences; as many keeps in France, so many examples. We shall select among these examples those presenting most interest from the point of view of the defense, for it would exceed the limits imposed on us in this work to give all.

Note 1.p.58. "If the night come that he must give them, he went (the chamberlain) to take the keys beneath the pillow of Gerard, who slept with madale Bertha in his keep, and opened the gate of the castle to the king of the French." (Gerard de Roussillon. Editio of Lyons.1856).

Suger [2] says some words of the castle of Roche-Guyon, with regard to the traason of William, brother-in-law of the king, toward his son-in-law Guy. "On the promontory, that forms in a place of difficult access the bank of the great river Seine, is built a castle of a noble but frightful appearance, named Roche-Guyon; invisible externally, it is excavated in a high rock; the skilful hand of its constructor has cut the rock

itself on the slope of the mountain by the aid of a narrow a and mean opening, and formed underground a habitation of very vast extent. Formerly, according to the general opinion, either a prophetic cavery where were received the oracles of Apollo, or the place of which Lucan says:- (Latin poem). Here one descends to the infernal regions."

Note 2.p.58. Vie de Louis le Gros. Chap. 16. Mem. rel. . l' hist. de France, translated by M. Guizot.

Suger speaks thus of the castle whose remains we see today. The subterranean rooms cut in the rock still exist, and if t they are not ancient caverns, if they do not descend to the i infernal regions, they date from a very distant epoch. Yet t the lodgings were not excavated in the cliff as Suger claims, but are built against a precipice of chalk cut by human hands. (Art. chateau, Figs. 8, 9). The castle of Roche-Guyon is in our days almost unrecognizable because of the changes it has suffered, one finds again there some traces of structures of the 12 th century; as for the keep, it is entirely preserved excepting its top, and its construction appears to belong to the meddle of that century.

Fig. 21 gives at A the location of the castle of Roche-Guyon. By a drawbridge B communicating with the upper stories of the castle, one reaches the platform C cut in the hill leveled at the peak; that platform gives entrance to a first ascending subterranean stairway, which lands at a second platform D in the open air. An excavation E intercepts all communication w with a third platform F. A wooden bridge, that could be destroyed in case of attack, alone permitted one to reach that t third platform. Thence by a long subterranean stairway with steps cut in the chalk and flint are not less than 11.8 to 15.7 ins. high, one arrived at G within the second enclosure of t the keep, built on the slope of the precipice. At K is traced the section of that subterranean stairs. It was absolutely i impossible to force a similar entrance, and the assailant, th a that had possessed himself of the castle, would have been easily crushed by the garrison of the keep. Let us now see how were arranged the defenses of the keep proper, placed in an exceptional position at Roche-Guyon.

Here (22) is the plan of the ground story of that keep. At A ends the subterranean passage; beside it is placed privies

in the thickness of the outer wall. A little post commands t the lower opening of the down flue from these privies. From t the entrance A to ascend to the keep, it is necessary to turn abruptly to the right and aslend the steps B, which land at t the postern C. At the left is found the screw stairs serving the upper stories. The landing before the postern outside was of wood, as well as the bridge B leading to the defensive gallery E, commanding the precipice. At F is a well, at S a little pit for preserving salted provisions.[1] From the internal enclosure of the keep one reached the outer enclosure by two posterns G G′, which are intact. Passing over an excavation F the besieged could pass outside by the outer postern H, perfectly defended by the two parapets intersecting at a right a angle. At I in a very recent epoch was pierced a second outer postern; but primitively the tower I was solid and formed a thick projection, defendable at the side where the assailant must direct his attack. A ditch cut in the rock surrounded t the first enclosure, and a system of palisades and trenches connected the keep tn an advanced work indicated in Figs. 8 and 9 of Art. Chateau. If we cut the keep longitudinally on the line O X, we obtain Fig. 23.

Note 1.p.60. In that little excavation the stones are deeply permeated by salt.

In this section one sees now the two curtains outside the principal tower rise in following the slope of the plateau to command the exterior on the side that can be attacked, how these curtains of the tower itself form projections at that side. From the principal tower the garrison passes into the defensive gallery of the second curtain by means of the drawbridge indicated at D on the plan; by a series of steps it arrives at the highest point R. Bw doors arranged in the parapet of this second enclosure, it passes to the defensive gallery of the first wall, whose highest point is at T. An assailant could not think of attacking the keep at the two sides M and N. (Plan in Fig. 22). He must necessarily direct his principal attack to the top at the angle I; but there if he wished to scale the ramparts, he would find behind the parapets the defenders massed on a wide platform; if he wished to employ the method of sap, he would meet with an enormous mass of rock a and masonry. Admitting that he could penetrate the first and

the second enclosures, it would be difficult for him to ascend to the defensive gallery of the external curtain, and he would find himself exposed to projectiles cast from the tops of the defensive galleries of the first and second curtains. The same difficulties would be found if he desired to pierce this second curtain. If he succeeded in passing it, it would be impossible to maintain himself and to act in the narrow space left between the second curtain and the tower. There was no other way nf getting possession of this keep, than by proceeding by a subterranean mine from the point T to the point S; now one understands that such an enterprise would be long and difficult in execution, the more so that the besieged could e easily countermine between the two curtains and destroy the works of the besiegers.

The side elevation (24) indicates the slope of that plateau of chalk, its precipice made by hand of man, the position of the subterranean works communicating with the castle and the different heights of the parapets of the two curtains, as well as the commanding by the principal tower. All in that structure is entirely without ornaments, and is profoundly calculated from the point of view of the defense. The reinforcement of the wallu of the two custains, as these walls become higher and approach the point, that can be attacked, the arrangement of the projections intended to resist sap, and to receive a considerable number of defenders at the extremity of the salient opposite the dominant part of the plateau, the manner in which the posterns are arranged so as to be masked from the assailants, all that is very sagaciously conceived and executed with care. Here the rule that "what defends must be defended," is perfectly observed. The structures are well built in rubble, with deges, arches and jambs in cut stone. In this is not a moulding, not a useless stroke of the chisel; he that o ordered it and he who executed it have only had the thought of erecting an impregnable post on this promontory; modern a artillery alone could subdue that little fortress.

It is certain that the feudal lords who inhabited these residences must die there of weariness, when they were obliged to shut themselves up there (which frequently happened); so o one should not be surprised if at the end of the 11 th and d during the 12 th centuries, they hastened to take the cross

and to risk adventures in the Holy Land. During the long hours of leisure left, to a lord shut within one of these gloomy keeps, hatred and mistrust must germinate and develop without obstacles; but also in properly formed souls, generous and matured resolutions with elevated thoughts must appear; for if solitude be dangerous for weak, minds, it develops and enlarges hearts well born. Indeed from the depths of gloomy keeps have c come those principles of chivalry, that have taken so great a part in the history of our country, and which in spite of faults, have contributed to ensure its greatness. Let us respect these ruins; if they recall odious abuses and even crimes, they retain the impress of the moral energy of which we still possess the tradition.

There still exists at Provins a keep built on the highest point of that city, so curious for the quantity of public and private edifices that it contains; this is the tower called Tower of Cesar, Tour-le-Roi or Notre-Sire-le-Roi. It is an actual keep from which were held most of the fiefs of the domain of Provins, and that was built about the middle of the 12 th century. The keep of Provins presents in plan an octagon with four sides smaller than the other four, the smaller sides being flanked by turrets engaged at their bases, but detached from the body of the structure in their upper part, thus permitting fighting all around. This keep could be furnished with a great number of defenders, because the different receding stories and the flanking position of the turrets..

Here (25) is the plan of the ground story of that keep, whose base was terraced in the 15 th century by the English, p probably to receive cannon. At C is seen the place occupied by that terrace. At P is a well to which one descends by stairs with entrance at F. At G is the oven established in the 15 th century; at H, the old chapel.

Fig. 26 gives the plan of the second story of this keep; it is only at the level of that story that one finds four posterns I communicating with the external curtain by means of drawbrodges. At the south side one of these drawbridges falling on a bent causeway, corresponding to the prolongation D of t the wall ending at the Paris gate, placing the parapet of the curtain in communication with the defensive gallery of this rampart. By the screw stairs K one ascends to the upper defen-

defensive galleries independent of the building. It is necessary to descend from the second story to the ground story, w which has no communication with the outside. In the thickness of the wall of the ground story is found quite a large dungeon, that is said to have served as a prison for John the Good, duke of Brittany. The second story presents a great number of cabinets, separate rooms suitable for lodging the chiefs. From the second story by four posterns I, one could easily pass to the defensive gallery of the curtain, now terraced.

The theird story (27) shows at K the landing of the screw stairs; at L are the defensive galleries with battlements reached by the little double stairs N; at Mare the four flanking turrets. Here as at Chambois a defensive gallery with tunnel vault is found below the upper battlements.

The section (28) made on the line A B of the plans of the ground and second stories, indicates the descent to the well, the posterns pierced at different levels, that on the right being the principal (because pierced opposite the road of arrival), not being in direct communication with the enternal h hall of the second story. At mid-height of the second story a are seen battlements defending the four principal facades; th then at the height of the third story is the defensive gallery with tunnel vault and the upper battlements, whose parapet is furnished with projecting defensive galleries projecting beyond the turrets. Today the structure is nearly destroyed above the level X X. The position of the wooden galleries of the four upper fronts does not seem doubtful; one cannot otherwise explain the recession arranged above the defensive gallery of the mezzanine, a recession that appears intended to support the feet of the great struts of these defensive galleries, s projecting sufficiently to form machicolations outside the u upper gallery. These galleries being thus arranged, flank the turrets, that themselves flank the fronts.

An external elevation (29), assuming the curtain wall cut on the line R S of the plan, Fig. 26, explains the arrangement of the posterns with the drawbridges O, as well as the stories of superposed defenses with the wooden galleries. The keep of Provins is built with great care. In the 16 th century these drawbridges existed no longer, the curtain wall razed and terraced left the sills of the posterns several yards above the

level of the platform, and men only entered the keep by ladders.[1] The groond and second stories, as shown by the section (Fig. 28), are vaulted, the upper vault being pierced by a r round opening to permit easy hoisting of projectiles to the upper defensive galleries, and to give orders from the top to the men posted in the hall of the second story.

Note 1.p.68. See the excellent work of M. Felix Bourquelot on Hist. de Provins. Provins. 1839. Vol. I. p. 305 et seq.

The principal defect of these fortresses, transferring one's self even to the time when they were built, is the complication of the defensive means, the narrowness of the passages, those multiplied arrangements of details, those tricks that in the moment of defense injured it, and prevented acting with vigor and promptness at the point attacked. These keeps of the 11 th and 12 th centuries are rather made to guarantee t them from surprise and treason thau against a strong attack directed by a bold and persevering captaio. From these narrow tops, encumbered, men defended themselves badly. At the moment of a pretty not alarm, the defenders even by their haste interfered with each other, encumbered the defensive galleries, and strayed in the numerous turns of the fortress. Thus when princes became sufficiently powerful to take in the campaign armies tolerably organized, numerous and acting with some unity, these Romanesque keeps could only defend themselves by their mass. Their garrisons were reduced to almost a p passive part, and could not do much injury to assailants well covered by mantlets and galleries, proceeding with system and already employing machines of a certain power. Philip August and his terrible adversary, Richard Lionheart, both great takers of places, tenacious in attack, possessing armed corps f filled with confidence in the valor of their chiefs, excellent engineers for their time, produced an actual revolution in the art of fortifying places and particularly keeps. Both felt the uselessness and even danger, from the point of view of the defense, of those prodigious bends in the last Romanesque fortresses. We have endeavored to emphasize the importance of the citadel of Andelyu and castle Gaillard, built under the direction and the eyes of Richard;[1] the keep of that fortress is for the time a work entirely remarkable. Richard first replaced the wooden defensive galleries and battlements by mach-

macnicolations of stone, conceived in a manner to entirely sweep the foot of the fortification on the side that could be attacked.

Note 1.p.62. Art. Choteou, Figs 11, 14.

The perspective (30) of the keep of castle Gaillard, taken from the side of the postern, explains the wise arrangement of these macnicolations, composed of arches borne on buttresses wider at top than base, and springing from a pronounced slope suitable to cause projectiles to rebound, when dropped throu-gh the wide openings left between these arches of the face of the wall. The plan (31) of this keep, taken at the level of t tne postern, which opens at the second story, shows the arra-ngement od this postern P with its slot sweeping the very ste-ep steps leading to it, and the wide machicolations above it; the windows opened toward the precipice, the projection A str-engthening the tower at the side attacked, and forcing the a assailant to show himself; the front B developed opposite the gate of the castle. The steps C landed at a postern of very difficult access placed on the precipice, and opening into t the enclosure well flanked as described in Art. Chateau, Fig. 11. The keep, whose foot is intirely plain and consequently protected from sap, is composed of a circular hall in the gr-ound story, to which one must descend, and a second story at the level of the postern P, a third story at the level of the machicolations with the defensive gallery and battlements, a fourth receding story, enclosed and suitable for a store of projectiles, and a fifth story with battlements and covered, commanding the defensive gallery and the outside afar (Fig. 30). On the side of the abrupt precipice D, which dominates the course of the Seine (Fig. 31), the machicolations were useless, for it was not possible for assailants to present themselves at that point; hence Richard did not construct any-In the interior the different stories were in communication together only by wooden stairs passing through the floors. T Thus in this keep is nothing too much, useless or not absolut-ely necessary to the defense. This work in our opinion unvei-ls in king Richard a military genius truly remarkable, a prof-ound study of the means of attack employed in his time, a pr-actical mind very far removed from the inconsiderate fury, t that modern historians attribute to that prince. Today these

structures are torn down to the height of the springing of t the machicolations at O.(Fig. 30).

However, this keep was taken by Philip August without the defenders, reduced to a small number, having time to take refuge in it; these defenses were therefore too restricted, and space was wanting; it must be stated that this tower must only be regarded as being the fortress of a very strong work, that served it as a curtain. The elevated doors of the Romanesque keeps, only to be reached by ladders or steps of difficult a access, in case of strong attack were a difficulty for the d defenders as well as the besiegers, if these defenders because of weakness of the garrison found themselves all compelled to descend to guard the exterior. But then as today, everywas garrison not in accordance in number with the importance of the fortress was compromised, and these forts must retain their own garrison, sacrificing the defenders of the outer works, if those works were taken. At the taking of castle Gaillard, Roger de Lascy, who commanded for the king John Lackland, possessing only the remains of the garrison reduced by the s siege of eight months, had been compelled to go with all his men to the breach of the external curtain of the keep to defend it; his and himself were surrounded by the numerous soldiers of Philip August hastening to the assault, and could only make their way to that narrow stairs to the keep; Roger de Lascy was taken, and the keep fell into the hands of the conqueror at the same instant. It appears that this experience benefited Philip August, for when that prince built the keep of the Louvre, he opened it by a postern almost at the level of the external ground with a drawbridge and ditch. Of the ke-keep of the Louvre only remain very brief descriptions and v very imperfect representations, we only know that it was cylindrical, that its external diameter was 65.6 ft. and its height about 131.2 ft. Philip August seems to have regarded the cylindrical form as that best suited for these last defenses. If the keep of the Louvre no longer exists, that of the castle of Rouen, built by that prince, still remains, at least in great part, and gives us a diminutive of the celebrated tower of the Louvre, from which were held all the fiefs of France. That keep intercepted the curtain of the castle and had two entrances beside the inner surfaces of that curtain. These

entrances were raised but little above the soil and were in c communication with small isolated stairs, on top of which fell drawbridges.

Here (32) is the plan of the ground story of the keep of R Rouen. At A A′ are two posterns; B B′ are the curtain walls, whose attachments are still to be seen. Beside the screw stairs that ascends to the upper stories are privies, and at C is a well. This ground story and the second story (33) are va vaulted; the walls are nearly 13.1 ft. thick. Today (34) [1] this structure is torn down to the level D, and we have only insufficient data for restoring the upper portion. However o one must admit that this upper part comprised, according to c custom, a story under a floor and a story for defense with i its covered way and a defensive gallery supported on stone corbels. The keep of the castle of Rouen held two curtains by absolutely interrupting communication froc one covered way to the other, since no exit opened from the interior of the keep into those covered ways. At the Louvre the keep was placed in the centre of a square court, entirely isolated, and did not command the outside in accordance with the ordinary rule. But the entire Louvre might be regarded as a vast keep, whose great central tower was the citadel. However the cylindrical form adopted by Philip August was evidently that best adapted to t that kind of defense, with regard to the means of attack of that epoch. That prince thought with reason that his enemies would employ for taking his castles the means that he himself had practised with success; for Philip August had had to make the siege of a great number of castles built according to the Norman system, and he could have recognized by experience, t that the angles of the towers and rectangular keeps always gave the advantage to the assailants. for these projecting angles were badly defended and perimtted the pioneers to attach themselves to their bases, to sap the foundations to the right and left, and to overthrow two sides of the wall. The cylindrical form gave no advantage at one point more than another, and admitting that the peineers could sap a segment of a circle, very extended excavations were necessary to cause a portion of the cylindrical wall to fall; further Philip August, as shown by the plan of the keep of the castle of Rouen, gave to the walls of his cylindrical keep an enormous thickness compa-

compared to their diameter. he spaced openings, rejected lower fllors of wood in order to avoidrisk of fire. This system prevailed during the course of the 13 th century.

Note 1.p.33. We owe these illustrations, plans, sections a and elevations, to the courtesy of M. Barthelemy, diocesan a architect of Rouen.

The keep of the Louvre was scarcely erected and Philip August in the tomb, when the lord of Coucy, Enguerrand III, pretended to build a feudal castle, whose keep far surpassed in strength and extent the work of his sovereign. That colossal enterprise was conducted with prodigious activity, for the castle of Coucy and its keep, begun at once after the death of Philip August in 1223 were completed in 1230. (Arts. Chateau, Construction). The keep of Coucy is the most beautiful military structure of the middle ages existing in Europe, and happily it is preserved to us nearly intact. Beside that giant the largest known towers, either of France, Italy or Germany, are only mere spindles. Further, that beautiful tower gives us precious specimens of sculpture and painting of the beginning of the 13 th century applied to feudal residences. The plans already given of the castle of Coucy in Art. Chateau, Figs. 16, 17 a and 18, show clearly the site of that fortress, so that it w will be unnecessary to return here to that entirety of the m military structures. We shall exclusively occupy ourselves he here with the keep, referring our readers to the Article cited for the explanation of its surroundings, its curtains and defenses, its external exits and its excellent site, so well chosen to command the exterior of the fortress on the side m most easily attacked, to protect the defenses of the castle itself. The diameter of the enormous tower, not including the bottom slope, is about 100 ft. outside, its height from the bottom of the paved ditch to the top is 180.5 ft., not comprising the pinnacles.

Here (35) is the plan of the ground story of the keep of C Coucy. The postern is at A; this is the single entrance defended by a draubridge vere skilfully arranged (Art. Poterne) by machicolations, portcullis, barred roods, a second barred door beyond the entrance stairs and a grille. A high curtain of m masonry protects the base of the keep at the external side, a and between that curtain and the tower is a ditch 26.3 ft. w

wideand entirely paved, whose bottom is 16.4 ft. below the sill of the postern. The entrance passage permits one to take at the right a stairs ending in a large screw stairs serving all the stories. Turning to the left one reaches the privies B. At D is a very large well, that has not yet been emptied, but which in its actual state is not less than 98.4 ft. deep. On the same level by the entrance corridor one enters a hall with 12 sides and 12 recesses in two stories to store provisions and arms; one of these niches, the second from the well, serves as a fireplace. That hall is lighted by two square windows very high above the floor, and was vaulted by means of 12 arches ending at a central keystone pierced by a round opening to permit hoisting to the top arms and defensive machines. We have made an excavation at the middle of that hall in order to determine if a subterranean story existed; but the excavation showed us only that the rock had very little depth, so that pioneers who succeeded in piercing the lylinder at t the level of the ditch could have passed through without finding a void anywhere. One will note that from the bottoms of the recesses to the exterior of the tower, the mansory has a thickness of not less than 18.0 ft.

The small stairs leads us to the second story (38), vaulted like the ground story, having recesses, three windows, privies and a fireplace E with an oven behind it. Below one of the window openings was placed in the 15 th century a cabinet with a private passage. this change is indicated on the plan by a gray tint. At the back of one of the recesses at the right is opened a narrou passage leading to a drawbridge D communicating with the defensiwe gallery of the curtain. (See description of the castle in Art. Chateau, Fig. 17).

Resuming the screw stairs, we ascend to the third story, w which presents one of the most beautiful conceptions of the m middle ages. This story is vaulted like those below it, and is composed of a hall with 12 sides surrounded by a gallery raised 10.8 ft. above the floor of this hall, thus forming a wide portico with balconies arranged to collect the entire garrison at a single point, permitting each one to hear the general orders and to see the commandant at the centre. Two windows and the central opening light this hall. Beneath the balconies at G are recesses adding to the area of the hall. The

screw stairs is arranged so as to give entrance at the right and left to the portico.

The fourth story (38) is covered, and is pierced by numerous slots and has battlements, stone corbels project strongly on the exterior, being intended to support double defensive galleries suited for the defense. The central vault was covered with lead like those of the portico. The battlements were closed by pointed asches and surmounted by a beautiful cornice with double crockets and a drip.

A section of this keep made at O P better than any description explains the grand arrangements of the great tower of the castle of Coucy. We have represented at the top a part of the double defensive galleries placed on stone corbels.(39). Four great stone pinnacles with cross-flowers and crockets surmounted the ridge of the battlement wall, these pinnacles are indicated in the engraving of Du Cerceau, and among the ruins t taken from the ditch, we have found fragments of them in a beautiful style of the beginning of the 13 th century. In that keep all is built on a scale larger than nature, sill walls in the openings of the battlements, steps of the stairs, benches and railings seem made for men above the ordinary height. The halls were entirely painted in the interior on a thin coat of lime covering the masonry, which is coarse.(Art. Peinture). The masonry is well built in courses 1.3 to 1.6 ft. high; the mortar is excellent with thick and well filled beds. The sculpture is treated with particular care and is among the most b beautiful of that epoch, it is entirely painted.

Engineer Metezau was charged by cardinal Mazarin to destroy the castle of Coucy, and wished to blow up the keep. For that purpose he charged a mine chamber at the centre and 6.6 ft. below ground, whose traces we have found. He thought thus to burst the enormous cylinder, but the explosion had no other result than to send the central vaults up in the air, and to cause three main cracks in the surface of the stone tube. M -atters remained in that state until recent times. New movements caused the fear of the fall of one part of the cracked tower, works of restoration were undertaken under the direction of the Hostorical Monuments dependant on the ministry of State, and today this beautiful ruin is protected from storms; the cracks have been repaired and the crushed parts consolida-

consolidated. Id the vaults were rebuilt, one would find the keep of Enguerranr III in all its wild magnificence. The truly original arrangement of the keep of Coucy is that of the third story designed to collect the garrison.

We endeavor to give a feeble idea of it in Fig. 40. If there be reproduced the thought of a thousand armed men gathered in the rotunda and its portico arranged like boxes of a wall for a play, few openings lighting that multitude, at the centre the master giving his orders, while men hasten to hoist by a windlass arms and projectiles through the openings of t the vaults. Or again at night some lamps are attached to the portico, the garrison sleeping or talking in that vast gathering of men, that one hears the noise outside coming through the central opening of the vault, the call to arms, the rapid steps of the defenders on the wooden defensive galleries, certainly one would imagine a scene of singular grandeur. However far the imagination of novelists or historians could go in s seeking local color, it would represent to them with difficulty what the view of such grand monuments, so simple in their arrangement, makes intelligible at a glance. Thus we advise all those sometimes desiring to live in the past to see the castle of Coucy, for nothing better depicts feudalism in its power, its customs, its entire warlike life, than this admirable remains of the castle of Enguerrand.

Norman keeps are barracks more or less well defended, built by craft and mistrust; petty means are accumulated to defeat the assailant, they are dens rather than eidifeces. At bottom is no general arrangement in those fortresses, but many expedients. The Norman keep still retains something of the den of the crafty savage; but at Coucy is recognized the methodical conception of the civilized man, who knows what he wishes, and whose will is powerful; here are no more experiments; the fortress is built rapidly at one spurt, all is foreseen and calculated, and that with an amplitude and simplicity of means made to astonish the undecided man of our time.

Yet already in the 13 th century, feudalism lost its heroic customs, and one may say that Enguerrand III is the last and greatest model of them. These dwellings of giantu cannot suit a nobility loving its ease, politacally weakened, ruined by its luxury, its struggles and its rivalries, foreseeing the

end of its power and incapable of retarding it. The great vassals of S. Louis and of Philip the Bold were no longer able t to construct such fortresses; they could not resolve to pass the days of a long siege in those great vaulted halls, dimly lighted, in company with their men at arms, partaking of their bread and provisions. Also a matter worthy of note, the Nr Norman keep is divided into a sufficiently large number of r rooms; the lord can live there alone, he seeks to isolate himself from his men, and even at need to ensure himself against treason. The keep of Philip August, of which Coucy presents the most complete specimen, is the last fortress, the refuge of an armed body acteng together, moved by the idea of unity of action. The tower is cylindrical; that form of plan alone indicates the system of defense proceeding from a centre where is the commandant, to extend and radiate, so to speak. Thus one sees appear among us in full feudalism that principle of military force, which first of all resides in unity of command and the confidence of soldiers in their supreme chief. And th this principle, that Philip August so well understood and put in practice, this principle adopted by some great vassals at the beginning of the 13 th century, feudalism abandoned when the monarchical power extended and drew to itself the force of the country. Thus the monuments always retain the imprint of the time that erected them.

The internal paintings of the keep of Coucy only consist of white panels on a yellow ochre ground, with beautiful borders around the archivolts. Soon men did not content themselves w with these decorations in a severe style; they desired to cover the walls of the halls with subjects, personages, heraldic arms, and legends. The feudal nobility loved letters, occupied themselves with art, aimed to instruct youths, and to p present before their eyes beautiful examples of chivalry. "In the year 1456, May 1, I, lord of Caumont, being at the age of 25 years, had a beautiful garden of flowers in which was abundance of birds, who sang beautiful and pleasing songs, and in several ways gave myself up to enjoyment, so that I thought much on the fact of this world, and I saw very subtle and inclined to do much, and that all this was nothing, compared to the other, that endures without end."

"And then I remembered my little children, young and innoce-

innocent, that I desired to become good and honorable, and h had good care, as a father should wish for his children. And because according to nature they must live longer than I, and that I could not teach or indoctrinate them, for it is necessary for me to leave this world, like others, I have thought that I should make and leave to them while here, a book of i instruction, to show how they should govern themselves, according to what is like myself." [1] This passage indicates the t tendencies of the feudal nobility at the beginning of the 14 th century, the times of savage violence were past; many lords devoted themselves to study of letters and arts, seeking to surround themselves in their castles with all suited to render these residences supportable, and to elevate the minds of youths."At the head of the said city (Mazieres) is a very beautiful and strong castle on the river, well enclosed ind with great machicolated towers all around it, and within all is painted marvellously with battles, and there are found all t the generations of Christians and savages, such a one, male and female, each according to the costume of his country." [2]

Note 1.p.83. Voyage du seigneur de Caumont, pub. by marquis de la Grange. Paris. 1858. Introd. p. 6.

Note 2.p.83. The same. p. 27.

We find the traces of these internal decorations of keeps already in the 13 th century. (Old French poem).[3]

Note 3.p.83. Lai de Guegemer. poems of Marie de France. 13 th century. Pub. by Roquefort. Paris. 1832.

Here the subjects of the paintings are borrowed from pagan antiquity. Frequently in these paintings, the artists interpreted in the most singular fashion the scenes of Greek and R Roman history, subjecting them to the chivalric manners of the epoch. Hector, Joshua, Scipio, Judas Maccabee, Cesar, found themselves comprised among the valiant knights with Charlemagne, Roland and Godfrey de Bouillon. The heroes of sacred aud profane history had their coats of arms like the chevaliers o of the middle ages.

Men that prided themselves on chivalric sentiments, who regarded courtesy as thefinest of the qualities of society, of a society of women as the only one that could form youths, m must necessarily abandon the gloomy keeps of the time of Philip August. Still it was always necessary to think of the de

defense. In the 14 th century feudalism renounced the great cylindrical keeps; it adopted by preference the square tower flanked by turrets at the angles, as more suited for habitation. On this programme Charles V caused the rebuilding of t the celebrated keep of Vincennes, that still exists, excepting some mutilations, that have modified the details of the defense.[1] This keep, commanding the exterior and placed at a longer side of the enclosure of the castle, is protected by a walled ditch and a rectangular curtain wall, with a gate well protected next the court of the castle. As everyone knows, it is composed of a square tower about 131 ft. high with four angle turrets ascending from the ground. Its upper part is d defended by two stories of battlements. It was always covered by a platform placed on the vault. In the interior each story was divided in several rooms, a long oblong one, one of medium dimensions, and a cabinet, without counting the turrets, these rooms for the most part had fireplaces, an oven, and were lighted by beautiful windows terminated by pointed archivolts. Already the keep of the Temple at Paris, completed in 1306,[2] had been built on this plan; its upper part, instead of being terminated by a platform, was covered by a hip roof with four conical roofs on the angle turrets, but the keep of the Temple was rather a treasury, a doposit of charters and money, t than a defense.

Note 1.p.84. "Item, outside paris (Charles V caused to be built) the castle in the forest of Vincennes, that is very notable and beautiful." Livre des fois et ponnes moeurs du sage roy Charles. (Christine of Piso).

Note 2.p.84. Du Breuil. Antiquites de Paris.

We believe it useless to multiply examples of the keeps of the 13 th and 14 th centuries, for they do not cause remark by their special arrangements' they are square or cylindrical; if square, they strongly resemble the towers built at that eo-epoch, and differ from them only in dimensions (Art. Tour); if cylindrical after the end of the 13 th centurw, they contain vaulted stories, and cannot be compared to the keep of Coucy, that we have just given. Only at the moment when feudal manners were transformed, or the lords castellans claimed to have residences less shut in and gloomy, did the keep abandon the form of the tower, that it had adopted about the end of the

12 th century to become that of a defended residence, but containing all that could render the habitation easy.

Louis of France, duke of Orleans, second son of Charles V, born in 1371 and assassinated at Paris in Nov. 1407 in Rue B Barbette, was a great lover of the arts. This prince rebuilt the castle of Pierrefonds, Ferte-Milan, Villers-Cotterets, ca caused to be executed considerable works on the castle of Coucy, that he had acquired from the last heir of the lords of Coucy. Louis of Orleans was the first that knew how to combine the defensive arrangements adopted at the end of the 14 th c century in feudal habitations with the comforts of a nobleman's residence. The castles that he has left us, and whose most c complete specimen we find at Pierrefonds, are not only magnificent residences, that would still be habitable in our days, but are strong places of the first order, that the artillery already perfected in the 17 th century could alone reduce.

It is strange that the influence of the princes of the younger branch descended from Charles V upon the arts in France has not yet been stated, as it merits. The monuments left by Louis of Orleans and by his son Charles ahe nearly half a century in advance of the movement of art in our country. The c castle of Pierrefonds, begun in 1400 and completed before the death of the first of the Valois, is still a strong place of the 14 th century, but decorated with refined taste like the residences of the time of Charles VIII.

The keep of this castle contains the lodging of the lord, n no longer enclosed in a cylindrical or square tower, but distributed so as to present a vast and commodious habitation, provided with the accessories required by an elegant anf exquisite existence, at the same time that it is a powerful and perfectly extended defense, impossible to attack other than w with siege batteries. now at the beginning of the 15 th century, siege artillery was still unknown. cannon were of small dimensions, carried in the campaign on horses or wagons, and were scarcely employed except against the formidable constabulary of that epoch. Let us examine the arrangement of the keep of Pierrefonds, that we have already given in the general plan of that castle.(Art. Chateau, Fig. 24).

The keep of Pierrefonds (41) [1] is near the principal entrance A of the castle, and flanks the entrance in a manner to

completely forbid approach. It also possesses the postern B, very high above the external ground. Thus it fulfils the ordinary conditions that desire the keep to have two exits, one visible and the other concealed. The gate A of the castle, p protected by a drawbridge, folding doors, a guard room a, portcullis and a second barred gate, had as a customary addition at that epoch, a postern for persons on foot with its special drawbridge b, and its bent entrance beside the guard room; fu further the corridor of the entrance was enfiladed by a turret placed on the buttress c. To enter the residence one found a beautiful flight of steps D with two horse-blocks (Arts. M Montoir, Perron), then a great winding stairway E ascending t to the upper stories. A false portal F gave entrance to the vaulted ground story serving as a storehouse for provisions. By sufficiently wide stairs G one descends from that great s story to the small cellar, arranged with recesses to receive wines of various sorts. The walls of this ground story are 9.8 to 13.1 ft. thick and are pierced by few openings, particularly on the external side. A little doorway H, masked in the r reentrant angle of the square tower allows entrance to the v vaulted hall I forming the ground story of that tower, and to take a stairs with straight flights ascending only to the second story. We shall return to that immediately. The postern B is equipped with portcullis and folding doors and surmounted by machicolations, that extend entirely along the curtain, w with its sill set about 23.0 ft. above the external ground, which at that place only shows a road 19.7 ft. wide; then below that road is a pronounced precipice, inaccessible, at the foot of which passes one of the stairs ascending to the castle, defended by a cross wall pierced by a door, on the other side of the door and commanding the walley is a mound of earth made by men, which was certainly crowned by a work now destroyed. From the postern B one can then, either by a plank or a drawbridge, defend the door of the stairs of the castle, pass above that door and reach the advanced work commanding the valley a afar. The postern B thus served for a sortie of the garrison, to take the offensive against the besieging force, and bring aid and provisions. One will observe that the space K is a co court with floor below the ground of the principal court of the castle, and that to enter that principal court, it was

necessary to pass through the second postern L, whose sill is raised above the ground K, and which is defended by a portcullis, folding doors and machicolations with battlements. T The stairs M, which admits to the chapel N and the court, ascends from the bottom, and allows one to reach the room of t the portcullis.

Note 1.p.85. One will note between this plan and that given in the entirety of the castle, are some differences of details, resulting from excavations executed in 1858 and 1859 in this domain by order of the emperor. These excavations have brought to light certain lower parts of the buildings, of which one could have had but a very imperfect idea. The plan that we now give may be regarded as properly accurate.

Continuing to ascend by this screw stairs, one arrives (42) over the room of the portcullis in the story pierced by machicolations; traversing the corridor, one descends a stairs O, which leads to the second story of the square tower, from which one can penetrate into the great rooms of the principal r residence, which consist of the vast hall P, in direct communication with the great winding stairway E, the two rooms S with lodging R above the entrance gate, and chambers located in the two great towers defending the exterior. At T are wardrobes, privies and closets. One still sees in place the beautiful fireplace, that warmed the great hall P, well lighted by great windows with tracery, with double transom bars. A third story was nearly similar to this, at least in general arrangement; both were defended only by the thickness of the walls and flanking by the towers.

Only on the fourth story begin to appear the defenses.(43). At the feet of the great gables that close the roofs of the p principal residence are placed machicolations with battlements at c and d. The two great round towers and the square tower continue to rise, separated above the roofs of the residence, and all three are crowned by machicolations with slots and c covered battlements, then above by a final parapet with battlements open to the sky at the base of the roofs. The square tower also has three flanking turrets on its three buttresses. At the height of the third by continuing to ascend the stairs M from the postern, one finds a parapet with battlements above the machilocations of that postern, and a door giving entrance

to the square tower, from thence one takes a little screw stairs V, which ascends to the three last stories of that tower, not in communication with the interior of the great residence. Yet from the story of the machicolations of the square tower may be taken a rampant stairs above the covering of the great gables with battlements of the principal habitation, rejoining the machicolations of the great angle tower, just as by the stairs of the turret C by ascending the steps behind the gables with battlements on that side, one can reach the machicolations of the great tower near the entrance. On the external front, these two towers are placed in communication by a parapet with battlements at the base of the roofs. From lobbies and wardrobes T one descends by the defensive gallery X of the great curtain defending the exterior with its turret X′ over the postern. This defensive gallery was also in communication with the lower defensive galleries of the tower of the chapel N. From the hall R or the tower R′, one could likewise reach the defenses of the castle on the south side by the room S 1 located in the fourth story above the entrance by descending the stairs M.

If our description has been followed with some care, it will be easy to understand the arrangements in general and detail of the keep of Pierrefonds, to conceive an accurate idea of the programme fulfilled by the architect. Vast storehouses in the ground story with the fewest exits possible. On the outside at the entrance side, which is that most favorable for at-attack, enormous and massive towers are solid for the height of the slope and able to resist the sap. At the side with the postern is a very thick and high protecting curtain with an internal court between that curtain and the residence, a second postern to pass from this first court into the principal court. As an excess of precaution, on that side is a very h high square tower flanking the residence on two of its fronts, commanding the entire court K and also the outside, with turrets at the top flanking even the sides of the square tower. Besides is a possibility of isolating the two round towers a and the square tower by closing some narrow passages entering the residence, thus rendering the defense independent of the habitation. A possibility of communicating from one of these towers to the other by the upper defensive galleries without

passeng through the rooms intended for habitation. Besides t the gate of the castle and the great stairway with a flight of steps is a private exit for the square tower, either by the little door at the reentrant angle, or by the stairs of the chapel. A private exit from the corner tower by the curtain in which is pierced a postern, and by the stairs of the chapel. A private exit from the tower of the entrance gate by the rooms situated over that gate and the stairs U descending to the ground. Easy communication established between the towers of the defenses of the castle by the defensive galleries. Rooms defending themselves, either on the side of the court K or on the side of the entrance of the castle by means of battlements and machicolations at the base of the gables. These rooms, well protected on the external side, masked and flanked, having but a single entrance for the apartments, that of the entrance flight of steps, and this entrance being placed in the court of honor, commanded by one face of the square tower. Impossible for every person not familiar with the arrangement of the residence to pass through these passages, stairways, turns and secret exits; and for him that lives there, a facility for passing rapidly to all points of defense, either of the keep itself or of the castle. Facility for making sorties if attacked. Facility for receiving aid or provisions by the postern B without fearing surprises, since that postern opens into a first isolated court, and only into the principal court by a second postern, whose portcullis and barred doors are guarded by the men of the keep. Beautiful halls are well arranged, orientated and lighted; private apartments with cabinets, lobbies and private stairs for service. Certainly it is far f from the keep of Coucy, which is only a tower where chiefs a and soldiers must live in confusion, and this last keep, which even today would be an agreeable and commodious residence' b but the feudal manners of the lords of the 15 th century resemble little those of the castellans of the begennning of the 13 th century.

We complete the series of plans of the keep of Pierrefonds by an elevation of this residence (44) taken from the side w with the postern on the line G 7 of the plans. At A is seen the great corner tower, at B is the square tower; between them are the two stepped gables of the halls; at C is the tower

of the chapel, into which the occupants of the keep could pass directly through the square tower and the little screw stairs marked M on the plans without going outside. There is visible the high curtain between the great angle tower and that of the chapel, which masks the isolated court R. At the middle of th that curtain is the elevated postern, that communicates with an advanced work by passing through the gate D of the external stairs of the castle. In construction nothing can rival the keep of Pierrefonds; the perfection of the jointing and cutting, of the setting of all the regular courses of a uniform thickness of 1.08 ft. between beds, is calculated to surprise persons that practise the art of building. In these walls of unusual height and of unequal thickness is neither settlement nor crack; all that was built with regular levels; no anchors a e found, and although the two round towers were blown up by mines, and the walls were sapped from top to bottom, yet the parts still standing seem to have been built yesterday. The materials are excellent, well selected, and the mortar has a perfect strength.[1] The numerous traces of woodwork, of the attachment of hangings, that are still perceived on the internal walls of the keep of Pierrefonds, sufficiently indicate that these apartments of the lord were richly decorated and furnished, and that this residence combined the advantages of a strong place of the first order with those of a pleasant h habitation situated in a charming country. Our custom if symmetrical arrangement in buildings after the 17 th century make it appear strange to see the irregularities noted in the plan of the keep of Pierrefonds. But as we stated in Article Chateau, the orientation, view, requirements of the defense, exerted the chief influence in the layout of these plans. Thus for example, the obliquity noticed in the eastern wall of the habitation (a skew not unseen in execution) is evidently imposed by the desire of obtaining windows on the exterior of a court, where the country presents changing points of view, and leaving the place necessary for flanking the square tower, as well as the internal postern between that tower and the chapel, the arrangement of the plateau also not permitting the greater p projection of the tower containing the chapel. The plan of the part intended for the apartments is given by the needs themselves of that habitation, each room having only the dimensions

necessary. In elevation the difference in height of the posts of the plan are even improved by the needs of the defense or of the arrangement.

Few castles of the 14 th and 15 th centuries possessed as extensive keebs, as beautiful and as suitable to lodge a great lord, as that of Piereefonds. Most keeps of that epoch, a although more comfortable to occupy than the keeps of the 12 th and 13 th centuries, however are only composed of the habitation more or less well defended. We shall find an example of those feudal residences at a reduced scale in the same province.

Note 1.p.90. The emperor Napoleon III recognized the importance of the ruins of Pierrefonds from the point of view of the history of the arts. The keep will resume its former appearance, already the portion of the square tower, that had be been destroyed, has been restored. we shall soon see the most beautiful specimen of the feudal architecture of the 15 th c century in France restored by the august will of the sovereign. We do not have so many ruins in our country, and we appreciate their value with difficulty. The castle of Pierrefonds, rebuilt in part, will make known that art both civil and military, which from Charles V to Louis XI was superior to everything then done in Europe.

The castle of Vez depends on the castle of Pierrefonds; it is situated not far from that domain on the edge of the forest of Compiegne near Morienval, on an elevated plateau that dominates the valleys of the Automme and the Vandi. Its military location is excellent and because it completes at the south the line of defense of the approach to that forest, protected by the two streams mentioned, by the castle itself of Pierrefonds at the northeast, the defiles of the forest of Aigue and the river Aisne on the north, by the plateaus of Champlieu and the market town of Verberie on the west, by the course of the Oise on the north-northwest. The castle of Vez is a very old post, placed at the extremity of a ridge between two little valleys. Louis of Orleans must have entirely rebuilt it, when he desired to take his precautions at the north of Paris, to be in a state to resist the claims of the duke of Burgundy, who on his part fortified himself at the south of the royal domain. Compared to Pierrefonds, Vez is only a post defended

by an enclosure and a little keep marvellously located, built with the greatest care, probably by the architect of the castle of Pierrefonds.[1]

Note 1.p.92. The mouldings of the keep of Vez, the mode of construction of certain details of the defense, recall exactly the construction, mouldings and details of the castle of Pierrefonds. The keep of Vez consequently dates from 1400.

This keep (45) rises at A (see general plan), at the angle formed by two curtains, one of which at B dominates a precipice B′, the other at C is flanked externally by turrets, and is separated from a lower court or bailey by a wide ditch. On the side G the plateau descends rapidly toward a deep valley: thus the two curtains H, H′ are lower than the two others at B, C, and their covered way is found at the level of the plateau on which rises a habitation K of the 12 th century almost entirely rebuilt at the beginning of the 15 th. That residence i in ruins today, but was a charming structure. The gate of the castle is at I, defended by two towers of small dimensions. One still sees some remains of the defenses of the bailey E, but now converted into walls and terraces.[1] The keep is d detailed in the plan of the ground story X. Its entrance is at L, and consists of a narrow postern with a drawbridge [2] giving admission to a large winding stairs ascending from the ground. Each story contains two rooms, furnished with fireplaces and closets. At P is a well. One sees at F the ditch and at V the entrance to the castle with its towers and skew bridge. The curtain C is defended by external flanking turrets O, while the curtain B, that had little to fear from attack from outside, because of the precipice, was protected internally by f flanking turrets R. By the little towers S S′ built at the t two extremities of the elevated curtains, men ascended to the defensive galleries and these curtains by means of stairs. At V was a postern descending from the platform of the precipice. When one examines the location of the plateau, the plan of the angle keep with external fronts sweeping the most accessible vicinity of the castle is perfectly explained. The small angle towers rising from the ground also form the flanking of t the second order, as a provision against a near attack.

Note 1.p.94. This domain now belongs to M. Paillet, the keep alone serves as a residence.

Note 2.p.24. This postern was replaced in the 16 th century by an opening at the level of the ground.

Fig 46 gives a perspective of the keep of Vez taken from the interior of the enclosure, and shows the arrangement of the f flanking turrets R of the curtain B, the postern with its little ditch and drawbridge, the opening of the well, the arrangement of the machicolation-privies, beside the stairs, the t tap of the stairs terminated by a turret serving as a watch tower. From the second story of the keep one passes to the d defensive galleries of the two curtains by small well defended doors. Thus the garrison of the keep, in case of attack, could repair quickly to the two curtains on the two fronts, which alone could be attacked. If one of these fronts at C were taken (it is the weakest on account of the nature of the ground and the opening of the gate), the defenders could still retain the second front B, strengthened by the internal turrets R (see plan), if they could not keep the second front, t they retreated into the keep, and renewed the offensive or ca capitulated at leisure. In a post so well arranged, a garrison of 50 men would easily arrest an army corps for several da days; it must be said that the assailants, surrounded by ravines, small streams and forests, stopped on such a location, would have great difficulty to protect themselves from a relief corps. Now the castle of Vez was nothing more than a fort intended to hold one point in the great line of well chosen defenses, perhaps there has not always been sufficiently observed the relation almost always existing in the middle ages between the various fortresses of a territory, they are studied separately, but no account is generally taken of their importance anf their relative utility. From this point of view, it appears to us, that the fortifications of the middle ages open a new field of studies.

Such is the persistent effect of traditions, even in epochs when one claims to be free from them, that we see the last v vestiges of the feudal keeps even enter into chateaus built during the 17 th century, when men no longer thought of the fortified residences of the feudal castellans. Most of our chateaus of the 16 th and 17 th centuries still retain at the centre of the building a great structure, certainly not a foreign importation, but much rather a last memorial of the keep

of the middle ages. We shall still find this habitation dominant at Chambord, S. Germain-en-Laye, the Tuileries, and later at the chateaus of Richelieu in Poitou, Maisons, Vaux near Paris, Coulommiers, etc.

DORMANT. Frame of Door or Window.

This name is given to a fixed frame of joinery, and to which is hinged the door or sash. In the first times of the middle ages, doors and windows were hinged in the rebates in the stone without frames; but this primitive means, a tradition of antiquity, had the inconvenience of allowing air to pass through these rebates, making interiors very cold in winter. When the customs of ordinary life commenced to become more effeminate, men claimed to have rooms well closed, and doors and w windows were hinged to wooden frames, fixed in rebates reserved in the stone. Frames appeared in private architecture only about the 15 th century.

DORTOIR. Dormitory.

Naturally dormitories occupied an important place in the old religious establishments. They are most frequently built in the extension of one transept of the church, so as to place the religious in easy communication with the choir for the n night offices, without going into the cloisters. When the season was rough or the weather bad, the religious descended under cover into the transept and from there passed into the ch choir. Dormitories were placed in the second story over cellars or services of the monastery, that produced neither odor, dampness nor too much heat. The dormitories of monasteries a are ordinarily divided lengthwise by a row of columns forming two vaulted aisles, or at least are ceiled; they receive light and air from the west and east, by reason of the position of the building imposed by the invariable orientation of the church. Great abbeys possessed dormitories built with magnificence, and presenting an appearance truly monumental. Modern science has recognized, that for each person during the time of slumber is required at least 1125 cu. ft. of respirable air. The lungs of the monks of the 12 th, 13 th and 14 th centuries, could consume a much greater volume of air, if it s seemed good to them, and still they rose after midnight to

chant matins.

Lebeuf [1] describes thus the dormitory of the religious of the abbey of Val Notre Dame dependent on the deanery of M Montmorency; "The refectory is quite a small square, it is beneath the dormitory, which is very light, and whose vault is separated by columns or old piers delicately wrought, as to be seen in several other dormitories of the order of Citeaux built in the 13 th or 14 th centuries." It is necessary to believe that the dormitories of the religious were arranged l like the dormitories of our barracks or our schools. Those g great halls were divided by low partitions into as many little cells as there were religious; these cells or stalls contained a bed and the most indispensable furniture, they must remain open or be closed only by curtains.

Note 1.p.97. Hist. du dicc. de Paris. Vol. IV. p.215.

In the 16 th century all religious orders desired to have cells or separate chambers for each monk, as practised in our seminaries. The same customs were observed in convents for w women. Yet from the 12 th century the Cluniacs, who were persons loving their ease, had already established chambers of distinct cells for each religious, and sometimes veen these cells were richly furnished. Peter the Venerable complained of them in his time, and S. Bernard arose with his habitual e energy against these abuses, that he regarded as opposed to monastic humility. Thus the first dormitories of the Cistercians seem to have been common halls furnished with beds, but without separations between them.

Here (1) is the external appearance of one of these common dormitories; it is the dormitory of the convent of Chelles ((convent of nuns); it was built at the beginniig of the 13 th century; [2] the ground story was occupied by cellars and the m meating room; a row of columns supported the carpentry forming two ceiled tunnel vaults with visible tiebeams. In Article Architecture Religieuse, we have had occasion to give a certain number of these buildings; it seems useless to enlarge here on their general arrangement, their form and the details of their very simple architecture, but perfectly appropriate to the object. Thus for example, the windows were habitually composed of a fixed transom opened especially to light the hall, and of a lower part to be opened for ventilatiou.(Art. Fenetre).

If each religious had a chamber, the name of dormitory was s still given to the building or story containing them, and p particularly to the wide middle corridor giving entrance to right and left to each cell. Yet there still existed in the 16 th century dormitories of convents of women arranged like the chambers of our barracks, i.e., consisting of several large rooms each containing several beds. We find the proof of this in the Pantagruel of Rabelais.[3] "But said the abbess, w wicked that yow are, why did you not give a signal to your neighbors in the chamber?"

Note 2.p.97. Monog. d. abbayes. Lib. S. Genevieve.

Note 3.p.97. Book III. Chap. 19.

DOSSERET. Pier. Jamb.

The end of the wall at right angles to another and supporting the lintel or arch of an opening. A A (1) are the jambs o of an opening.

DOUELLE. Intrados.

This is the internal surface of an arch, also designated by the name of intrados. In a vault, each voussoir has its intrados. A is the intrados of the voussoir represented in Fig. 1.

EBRASEMENT. Splay.

This indicates the space between the frame of the window and the surface of the internal wall of the room. This splay is enlarged toward the interior to facilitate the entrance and to also receive the folds of a casement window.(Art. Fenetre).

ECAILLES. Scales.

Employed only in the plural to designate a sort of ornamentation very common on edifices in the middle ages to decorate the caps of buttresses, slopes of gutters, tops of pinnacles, stone spires, etc. Scales are evidently an imitation of covering by wooden tiles (Art Bardeaux); thus it is especially in provinces where that sort of covering was employed, i.e., in Normandy, Picardy, Soissonais and in Ile-de-France, that scales appear on stone structures from the 12 th century. In Normandy itself it is not rare from the beginniug of that century to see certain vertical surfaces, grounds of blind arcades, f

for example, decorated by scales sculptured on the stone and presenting a very slight projection. This was one means of distinguishing those grounds in the midst of the solid parts of the construction, of studying them, so to speak, and for rendering them less heavy in appearance. The reliefs in the 11 th and 12 th centuries, in which are represented edifices, frequently show the surfaces of those edifices thus decorated. We have given a remarkable example of them in Art. Architecture Religieuse, Fig. 47, taken from a capital of the church of S. S Sauveur of Nevers. The singular church of Thaon near Caen shows us a portion of its external surfaces decorated by scales of square form, recalling those facings with wooden tiles so much in use in private structures built of half timber work. These scales are sometimes superposed or more frequently contrasted, i.e., solids over voids, as indicated in Fig. 1. By dividing the rainwater that strikes the suffaces, by removing dampness from the joints and discharging it, these scales in addition to their decorative effect have still the advantage of preserving external surfaces. If this effect be sensible on vertical walls, by a stronger reason it is so on inclined surfaces, or slopes directly opposed to rain. On elevated inclined stone surfaces, every projection of a form suitable to direct the water is eminently favorable to the preservation of the masonry, by avoiding the uniform soaking of the rain. Whether the architects of the 12 th century had that experience, or merely had in view the decoration of inclined surfaces (further a logical ornamentation since it recalls a covering to tiles of clay or wood), these architects always adopted scales carved on the stone for every inclined surface.

The oldest forms given to these scales present a series of rectangles or billets as shown in the adjacent Fig., or with little round or pointed arches as indicated in Fig. 2.[1] It m must be stated that each row of scales is always cut in the height of one course, the vertical joints being placed at the middle of the spaces left between the scales. Rainwater falling between A and B is led by the cut stone along the two edges A C, B C; at C it drops off and reaches the eud D, and so successively to the cornice. The parts most wetted are then the edges of the scales' but even by their projection these edges dry more easily than the flat surfaces; dampness then remains less time on the surfaces, this is the entire secret

of the preservation of these surfaces covered by scales. Delicate shadows and lights, that play on these little sculptured surfaces, give lightness and elegance to the coverings, th thus architects have also used this means in the epoch of the Renaissance. We cannot pretend to give all the examples of s scales cut on surfaces, but will content ourselves by indicating the principal ones.

At the end of the 12 th century scales, particularly in the edifices of Normandy and Ile-de-France, take the form of little stilted pointed arches, as indicated in Fig. 3. Until then scales project little and present equal relief in their entire length. But in the great monuments erected at the beginning of the 13 th century it was necessary to obtain pronounced effects in the execution of details at so small a scale; thus we see in Picardy, for example, on the pyramids surmounting the stairways of the two towers of the facade of the cathedral of A Amiens scales in strong relief, and in a form evidently intended to produce a great effect at a distance.(4). In Ile-de-france, the architects never exaggerated thus the importance of details, that after all should not destroy the quiet of p plane surfaces, and that are not made to contrast with sculpture. Yet sometimes the scales cut on edifices of the first h half of the 13 th century in Ile-de-France present greater p projection at their lower ends than at top. their most general form is that presented in Fig. 5. In this case the scales are cut according to the profile A or B. Scales strongly detached at their lower ends according to profile A belong rather to spires of towers, i.e., that are placed at a great height. On the slopes of buttresses their projection is equal f for their entire length.

In the 14 th century scales approach more nearly to the form of wooden tiles; they nearly touch each other, have their two sides parallel, are elongated and terminated by clipped corners.(6). The pinnacles of the choir of the cathedral of Paris (14 th century) and those of the cathedral of Eu (15 th century) are covered by scales cut in that form.

Scales belonging to monuments erected in the provinces, and on which stone roofs have been adopted since the Romanesque e epoch, as in the South and West of France, are not arranged like wooden tile coverings; they are returned so as to leave

between them as many little channels suited to remove water f from the vertical joints. (See what is said on this sort of scales in Art. Clocher, Figs. 14, 15).

ECHAFAUD. Scaffold.

In the art of building, by a scaffold is understood the temporary carpentry work established to permit the construction of the masonry. Scaffolds are attached to the construction or are independent of it. The structures of the middle ages, like the Roman buildings, were erected by means of scaffolds attached to the masonry, and that were fixed in building it. For this purpose men left in walls of bricks, rubble or cut stone holes about 6 ins. square, deep, in which were fixed projecting timbers or logs or putlogs, and the holes left to receive them are called putlog holes, the vertical blocks are termed struts. The architects of the middle ages built thus their l largest edifices by means of putlogs and struts of moderate size. On these putlogs, placed quite near together, were laid planks, platforms, on which the workmen remained; these stages of more or less width according to need, were repeated at each 6 ft. at most, so as to make every part of the structure accessible to the workmen. Materials of large size were never placed on these stages, but on the walls themselves, by means of machines placed on the ground corresponding to cranes or hoists fixed on the structure itself. Besides, the materials were nearly always hoisted inside, landed on the walls, set and jointed by the workmen moving on the walls or the scaffolds.

The scaffolds of a Roman or mediaeval edifice then rose at the same time as the construction. The constructors of those distant times certainly did not incur great expense for scaffolds. They left the putlog holes visible on the surfaces, only taking the trouble to fill them when they removed the scaffolds after the construction was completed. Then the edifices were not dressed after erection, each stone was set entirely cut, and nothing more was to be done; on the day when the last stone was set in place, the edifice was completed, and the scaffold could be removed. It must also be stated that the g great Gothic edifices presented strong recesses at different heights, which permitted the starting of a system of scaffolding on each recession, without its being necessary to support

the scaffolds from the ground. Yet there are edifices, for example defensive towers, that rise vertically to a great height without projections or recessions. It is interesting to study how those enormous structures were erected.

The construction of the keep of Coucy, that presents a cylinder whose vertical surfaces are 197 ft. high, required only an extremely simple scaffold, one that had also the merit of avoiding the slow hoisting by machines. One notes on the external surface of the enormous cylinder a series of putlog holes arranged in a spiral and forming a very gentle slope by r reason of the unusually large diameter. These putlog holes a are spaced about 13 ft. apart, and are double, i.e., exhibit two spirals as shown by Fig. 1. By means of timbers fixed in the upper holes - and relieved by struts resting in the lower holes B, the constructor thus established at the same time he erected the structure a spiral road whose small inclination permitted the transport upwards of all materials on little ca carts drawn by men or by windlasses placed at certain distances. Fig. 2 will illustrate that operation. The masons and s setters took care to level always the construction around the entire circumference of the keep, as shown here, and on that level they passed and unloaded the stones. To set the external surfaces vertically (surfaces cut previously on the work yard), there sufficed a plumb line and a wooden radius bar t turning horizontally on a vertical axis fixed at the centre of the tower. Our masons now proceed in the same manner, when they build those great brick chimneys of iron works, from the interior of the flue without scaffolds. The scaffold whose t traces exist on the walls of the keep of Coucy is actually o only a transport road, and this road might be very wide as s shown by Fig. 3, giving one of its fixed trusses. At A and B are two holes spaced 3.9 ft., by two ties G connecting the t timbers next the holes, one could have two struts E F, the l latter forming an X-brace to a tie G. The head of the strut F and the foot of the tie G enter into a post H, fastened to the timber B at its lower end. A final strut K enters the foot of that post H and relieves the end of the upper timber A. It would thus be easy to have a road 17.4 ft. wide inside a railing. These small trusses received beams that supported cross planks placed to fresent an obstacle to the sliding of the c

carts. It would have required an enormous load to break the trusses so combined, although they were held in the wall only by two fixed ends. Not only the combination of these little trusses prevented them from leaving the holes, but being connected by beams forming a series of polygons around the cylinder, they were always fixed against the wall.

In the provinces where men still built without dressing the front after setting, they have retained these primitive modes of scaffolding. The scaffolds are composed only of putlogs f fixed in holes arranged in building and with poles, the putlogs being fastened to the poles by cords. Even in Paris these traditions are retained, and men from Limousin display singular skill in the construction of these light scaffolds composed of logs with diameters averaging scarcely over 4 ins.

In Burgundy and Champagne (a forested country), we have often seen scaffolds used according to the perspective sketch. (4). The part A of the horizontal timber A B is fixed in the putlog hole, this putlog is framed at C at the face of the w wall as indicated by the detail C'. Two pieces D are halved together at top, rest against the wall and are connected by the tie E. Two struts G G are framed to the feet of these pieces and support by tenons the end of the horizontal timber A B. This is a hanging truss with two struts that prevent the horizontal timber from bending to right or left under the load to keep it rigid.

It is doubtful that the carpenters of the middle ages, who were very ingenious, in certain cases built scaffolds of carpentry independent of the construction, scaffolds rising from the ground or suspended. We can only have an idea of these s scaffolds by the traces of their anchors still existing on t the monuments. For example, it occurs that above the story of a building so arranged that one cannot erect scaffolds from the ground, there are perceived square holes of 12 by 13 ins. piercing the wall at certain parts, and so spaced as to leave between them the length of a beam, over these well formed large holes are noted other small putlog holes about 4 ins. square and not passing through the masonry. That indicates to us the placing of the scaffold arranged as indicated in Fig. 5. A B is the thickness of the wall; the beams C pass through it and are fixed inside by strong keyed blocks D; two vertical

ties E pivots the beam at the face of the wall on the exterior; into these are halved two struts F that relieve the beam at G and H. On this beam thus made rigid are then erected the scaffolds by poles I and putlogs L with braces K, the putlogs being held by wooden wedges in the holes left in the external surfaces. Such a scaffold offers all the solidity of a carpentry structure rising from the ground.

The excessive height of certain Gothic edifices, and notably the towers of churches surmounted by stone spires, was such that one could not think of erecting these structures by means of scaffolds rising from the ground, for the establishment of these scaffolds would have absorbed considerable sums, and they would have had time to rot ten times during the work of the masons. men erected substructures with poles and putlogs; they profited by recessions carefully arranged in those kinds of structures that take new points of support above the ground; then attaining the height of the platform or galleries from w which the towers rise independently, the lower scaffolds were removed to erect the carpentry yecessary for the construction of these towers. The openings of these towers were then of g great assistance for setting stable scaffolds, suited to resist the violence of the wind and all causes of destriction, w which increase from the time that one ascends much above ground.

However little one examines carefully Gothic structures, he remains persuaded that the architects charged with erectiug them frequently lacked resources corresponding to the nature and importance of these buildiugs. They must then be very saving with scaffolds, that cost very dear and represent nothing after the building is completed. Above a certain height o one also recognizes by the position of the scaffold holes, t that they were suspended. To suspend a scaffold from an already existing monument requires no very wise combinations; but to suspend a scaffold to erect an edifice, before that structure is built, is a problem that seems difficult to solve; o one knows that material difficulties did not stop Gothic architects.

Usually the towers of great churches at the height of the b belfries in their upper parts and below the spires, are pierced by narrow and high double openings. The angles are strengthened by buttresses terminated by pinnacles; but in the reen-

reentrant angle formed by these buttresses, and according to the diagonals of the square on which the plan of these towers is traced, one nearly always notes at the base of the belfry larger or smaller holes, and sometimes rests. Above the vertical portion of the tower, at the base of the spires that ri rise on an octagonal plan, are seen dormers at the eight sides, openings more or less wide, but narrow and high. These a arrangements lead us to admit that the scaffolds intended for erecting the upper and independent parts of church towers were suspended, i.e., that they left the lower part of the facades entirely free. Starting from this principle, let A (6) be the plan of a tower of the facade of a great church at the base of the belfry, B being the plan of this tower at the base of the stone spire, that crowns it. Having two openings on each face of the belfry, we place across these openings scaffold t trusses intersecting at C, and approaching as nearly as possible to the angle buttresses. In elevation each of these trusses gives the sketch F; the four posts G rise in a single piece or are doubled from E to H (on account of the height of t the belfry); from H to K is a plate passing from one opening to the other. The two struts I L are halved together and strongly relieve these plates. From the point M hang double inclined ties M N, which support the end of the horizontal timber N O resting on the sill of the opening; horizontal putlogs P stiffen the entire internal system and have their outer ends pinched by the great inclined ties M N, form as many scaffolds for the masons. Thus before the tower was erected, the suspended scaffold could be built. The structure being carried up to the level of the plates H K, we set on posts G other posts G′, other plates R S, struts T V, then double ties X, that a again suspend the ends of the first plates ind the intermediate scaffolds. One notes that the second plates R S and the struts T pass through the stone spire in holes purposely arranged, closed later or left visible. From dormers on the four faces of the spire, parallel to those of the tower pass timbers as brackets to prevent the vibration of the scaffold. The eight openings of the belfry thus permit scaffolds to project beyond the construction, on which can be placed platforms. T There remain the angle scaffolds. For this we have the great middle post a b, and rest c at the reentrant angle, and a hole

reserved at d on the diagonal of the square (see sketch J on the diagonal of the plan); that suffices. The plates e f passing through those holes rest on the posts G and the central post, and are relieved by the large struts i l; two hinging ties n o suspend the intermediate platforms. Attaining the level e f, we find the continuation of the middle part of the posts G; we assemble the second plate p q, the struts r s that relieve it and pass through the dormers of the spire; we arrange the hanging ties t v, and connect these diagonal timbers with the parallel ones by means of horizontal beams, which at different heights extend entirely around the spire. T The construction being finished, all these scaffolds are easily removed through the interior.

To see these arrangements still existing on the exteriors of great edifices of the middle ages, it is certain that suspended scaffolds were much used then. During the 14 th and 15 th centuries the monuments of an earlier epoch were much repaired, either because their surfaces were injured, or because it was desired to place them in harmony with the new forms. T In the case of removals or of external restorations, these sc scaffolds were very useful because they did not obstruct the ground story, and cost far less than scaffolds rising from t the ground. The carpenters established a series of principal platforms (7) by means of beams A fixed in the masonry, whose overhang was supported by great struts B and by suspended ties C. If the space required between the frames was too great to place simple beams between them, hanging frames D were placed from one beam to the other, whose arrangement is detailed in the perspective sketch (8). The ends a b are set in the wall; the suspended ties are indicated by V; the trussed beams at F. Planks P resting on these beams form the principal scaffolds on which the materials could be placed. According to the method employed by the carpenters of the middle ages the ties were fastened by means of wooden keys, without any need of bolts and ironwork. In sacffolds as in all structures of that epoch, men sought to economize materials, and did not take into account the workmanship. In our time we see scaffolds simply and solidly combined; yet it must be stated, that architects too readily abandon the direction of that accessory yecessary to every important structure; a little study and attention on

their part would avoid much useless expense, and due to the deplorable system of settlements, we are often compelled to employ carpentry contractors unable to find the best means to build stable scaffolds by useing little wood. But a well made scaffold is one of the parts of the art of the constructor, t that best emphasizes his intelligence and his good direction. One can judge the real science of the constructor by the manner in which he arranges his scaffolds. Well built scaffolds save time for workmen, give them confidence, lead them to greater regularity, system and care; if they are massive, they use wood properly, the workmen know how to recognize this perfectly; they judge by this temporary work the degree of the practical knowledge of their chief, and have no liking for that abuse of means. If on the contrary, masons are called to work on bold scaffolds, apparently light, but which some days of testing suffice to prove their stability, they very quickly appreciate these qualities, and understand that in the work required from them is care and accuracy, that men will not be content with "nearly so." In the restoration of ancient edifices, the scaffolds require from the architect great fertility in combinations; one cannot devote too much attention to this study; economy, order in the work, and more than all, the lives of the workmen depend on it.

ECHAUGUETTE. Watchtower. Turret. Watch Turret.

In the middle ages this word denoted a Sentinel. (Old French poem). 1, 2. Also the guard or post. (Old French poem).[3] Men used it for guarding and watching. (Old French poem). 4

Note 1.p.114. Roman de Rou. Verse 9549 et seq.

Note 2.p.114. Roman de Garin le Loherain. The form "eschouguite" is preferable, and is employed in the same privince. (old French poem). This word is formed from Scoure, interpreted in the monuments of the 8 th century by turma, acies, and by wachte, guard. Scaraguayta.

Note 3.p.114. Roman d'Ogier l'Ardenois. Verse 1122 et seq.

Note 4. The same. Verse 10736.

During the 14 th, 15 th and 16 th centuries in north France, the little cells intended for sentinels on towers and curtains are called indifferently by names given in the text.[5] Thus the post takes the name of the sort of man enclosed.

Note 5. p. 114. Archives of Bethune, peronne, Noyon. Les artistes du nord de la France aux 14^{e}, 15^{e} et 16^{e} siecles, by Al. de la Fons, baron Melicoco. Bethune. 1848. -- Repairs of the fortifications of Bethune, Arras, Grise, Noyon, Peronne, etc. Registre des comptes, p. 185 et seq.

In the most ancient fortifocations of the middle ages were wacth boxes. It is to be believed that those first watch boxes were of wood, like defensive galleries, and that they were set up in time of war. All the tops of fortresses preceding the 12 th century being destroyed, we cannot give an idea of the exact form of these primitive watch boxes, whether they did not consist merely of little wooden boxes, but if they were constructed of masonry, they were only little square or cylindrical turrets crowning the angles of the principal defenses, like those that we have shown at the top of the keep of the castle of Arques. (Art. Donjon, Figs. 7, 8, 9). The first permanent watch boxes of which examples are found, are not earlier than the 12 th century, then they were lavished on the d defenses; they are either closed, covered and even furnished with fireplaces; or they only present a projection at an angle or along a curtain, so as to offer a small flanking turret to facilitate oversight, to place a sentinel or watch. It was especially in the vicinity of gates, at the angles of great works, at the tops of keeps, that were constructed watch turrets.

We see four beautiful watch turrets crowning the keep of Pr Provins (Art. Donjon, Fig. 27 et seq.); these were covered a and each could contain but one man. Sometimes the watch turret is a little closed post capable of containing two or three soldiers, like the upper guard. At the top of the keep of Cham exists one of these watch turrets of the 13 th century, above the stair tower of the 12 th.

Here (1) is the internal appearance of this post, which could contain four men. It is vaulted and is surmounted by a te terrace formerly with battlements. A little window looking o out on the country lights it, a fireplace permits warming it; on the right of the fireplace is a shelf intended to receive a lamp. The men of the post could easily ascend to the upper terrace to observe what passed at a distance. These great turrets in two stories are quite common; it is to be believed t that in time of war the soldiers sheltered in the covered story

were placed as sentries in turn on the upper terrace. On the two sides of the tower of Tresau at Carcassonne we see likewise two high turrets thus combined; only it was necessary from the closed story to mount on the terrace by a ladder, passing through a hole made in the middle of the little vault. (Art. Construction, Fig. 154).

It is always necessary to distinguish watch turrets only i intended for oversight at a distance, from those rising at t the same time for watch and defense. Keeps always possessed at least one watch turret, on the top of which was a sentinel by day and night, who by sounding a horn warned the garrison in case of a surprise, an unusual movement outside, or a fire; who announced the rising of the sun, curfew, the return of a body of soldiers, the arrival of strangers, the departure and the return from the chase; "the night having been slept through, and when he heard the sentinel sound the day, he rose a and went to the church to praw God to aid him."[1] This sort of watch box consisted of a turret dominating the vicinity above the battlements and roofs. Certain keeps by their location a alone, like the keep of castle Gaillard and that of Coucy had no need of watch turrets; their upper defense took their places; but keeps composed of several lodgings connected together, like the keep of Arques and much later that of Pierrefonds, for example, must necessarily possess a watch turret. In the castle of Carcassonne, which dates from the beginning of the 12 th century, the watch turre is a special tower with rectangular plan, containing stairs with a terrace and battlements on top. That tower dominates all the defenses of the castle and even those of the city; it encloses for about two thirds its height a little post lighted by a window looking out on the country. (Art. Architecture Militaire, Figs. 12, 13). Watch turrets only intended for observation offer nothing special, they are turrets, square, polygonal or most frequently cylindrical, that terminate stairways above the principal towers of castles, much exceeding the level of the crests of the highest roofs. Watch towers serving to contain a post or even one sentinel able at need to act for the defense of a place, on the contrary are very interesting to study, their arrangements being much varied according to the places they occupy.

About the end of the 13 th century, the gates are customari-

customarily furnished with watch turrets corbelled at the angles of the building above the entrance.(Art. Porte). These t turrets at the same time served for the sentinels and for flanking. The beautiful gate at Prague in Bohemia, that defends the old bridge thrown over the Moldau, on the side of the old city, is furnished at the four angles with charming watch turrets, whose appearance is presented here.(2). They start from a column surmounted by a broad capital with sculptured corbel; on this first slab are set little columns. (See plan A) leaving between them an opening purely ornamental, at the height of the upper battlements is a watch turret also pierced by o openings.[1] This work dates from the middle of the 14 th century, it is in perfect preservation and built of sandstone. B But here the turrets are as much an ornament as a defense; w while those flanking the gate of Notre Dame at Sens (3), erected about the beginning of the 14 th century had a character purely defensive, the upper turret was in two stories and presented slits and openings properly arranged to enfilade the front of the gates and protect the angle.[2]

Note 1.p.118. La Chronique de Boine. Chap. 8.

Note 1.p.118. If we give this example here, this is because it seems to us to be the work of an architect from Picardy. Indeed in Bohemia during the 14 th century, men had recourse to architects from our country. Thus the choir of the cathedral of Prague was built in 1344 by a Frenchman, Matthew of A Arras, called to Bohemia by king John and his son Charles, m margrave of Moravia. Among the heraldic shields that decorate the gate on the old bridge is found the shield of France spotted by fleurs-de-lis without number, and consequently older than Charles V.

Note 2.p.118. This gate, which retains traces of the balls of the allied armies in the invasion of 1814, was destroyed s some years since without any serious reason. It was a charming ruin.

If the flanking watch turrets were placed beside the gates, for a stronger reason they were placed at the projecting angles formed by the curtains, when any reason prevented the finishing of these angles with a round tower. For example, it o occurred that the nature of the ground did not permit the erection of a tower suitable in diameter; or indeed that the m

military architects desired to make a rectangular projection, either to mask a postern or to flank a front, yet without encumbering the place by a tower, that might injure the safety of the defense. Thus for example, on the southeast front of the external enclosure of the city of carcassonne there exists a redan A (4), suggested by the presence of a great cylindrical advanced work K, called the tower of Papegay, that was erected at that point, at the apex of a very obtuse angle, to command both the outside at G and the interior of the lists (the space left between the tow enclosures) at L, beyond the rectangular projection. Consequently is was not necessary to erect at the angle C of the rectangular projection a tower, t that would have obstructed the covered way B; yet it was essential to protect the front B, the flank A and the salient a angle itself. They built therefore at that aigle a large watch turret, that sufficed to protect the salient angle, but co could not injure the command of the great tower K.

Fig. 5 reproduces the external view of that turret,[3] whose battlements were a little higher than those of the adjacent curtains. In time of war that work could be equipped with defensive galleries, which much increased its strength. Between gate Narbonne and the tower of Tresau of the same city was t thus placed a redan, that enfilades the entrance and the barbican raised before that gate; this redan is surmounted by a beautiful turret. A long flanking slot is opened at its summit.

Note 3.p.118. This watch turret dates from the 13 th century.

Fig. 6 presents at A the plan of the redan at the level of the ground of the city, with its little post E and the slot F looking toward the gate Narbonne. From this post E by a screw stairs is reached the turret (plan B), which is only the battlements of the curtain forming an oblique flanking corbelled out on the angle C. The section C made on the line O P of the plan B explains the construction of this turret, which could be equipped with defensive galleries like the curtains, at D we have represented the section of the corbelling H.

Until the 14 th century, flanking watch turrets placed on the curtains are always only accidental, and are not connected with a general system of defense; while after that epoch we see these turrets adopted regularly, either to supplement the towers, or to defend the curtains between two towers. But this

fact compels us to make some explanations.

From the Roman epoch until the 12 th century, it was admitted that a place was much stronger when its towers were near together, and we have seen that at the end of the 12 th century again, Richard Lionheart in building castle Gaillard, composed its last defense of a series of towers or segments of c circles almost in contact. When in the 13 th century casting machines had been perfected, and men had at command hand crossbows of a longer range, as a result they must leave a greater distance between the towers, and thus increasing the fronts, place flankings in proportion to their extent, i.e., give the towers a greater diameter, to be able to place therein a greater number of defenders. If it was an advantage to make the fronts longer, there was an inconvenience in much enlarging the diameter of the towers, for that gave protection to the assailants in a great number of cases, as for example, w when they succeeded in getting near the wall between two towers, and had destroyed the upper defenses. Every system carries with it the defects inherent in its qualities themselves. Since the casting machines had a longer reach, it was necessary to extend the fronts as much as possible, yet one could not neglect the flanking, for if the assailants reached the f foot of the curtain, these became necessany; now the more formidable the flankings, the less the fronts could render service for a distant defense.

Let (7) a front A B be furnished with towers; B C is the w width of the ditch; the reach of the crossbow is E F. If the assailant arranged his attack according to the line F G H, n nine embrasures covered it. But let I K be a continuous front not flanked by towers, the attack being arranged just as here at F G H, the embrasures being also pierced at distances equal to those of the front A B, 13 of these embrasures could c cover the assailants. When he passed the ditch and posted himself at M, the besieged could only defend themselves by the machicolations placed directly over the point M; but they saw at a greater distance the nature of the operations of the enemy, and disturbed him by sorties in the bottom of the ditch, where he found no protection.

When a place was regularly besieged at the end of the 13 th centurw, (Art. Siege), two towers were usually attacked, only

to stop their fire as now said, by dismantling their upper d defenses, and a breach was made by sap in the curtain between these two towers; for these being made powerless, their mass protected the assailants by covering his flanks. At the time of the definite use of stone machicolations instead of wooden galleries about the beginning of the 14 th century, there was evidently a reaction against the defensive system of the front courts; towers were spaced farther apart, the fronts were enlarged between them, and to protect these fronts without lessening their qualities, they were finished with turrets P, as indicated by the sketch N O, Fig. 7. This new system was especially applied in the defenses of the city of Avignon erected at the same epoch. These defenses must have always been quite weak, but with regard to the small relief of the curtains, an excellent system of lanking turrets has been devised, and the weakness of the defense does not result from the new mode adopted, which had the result of compelling the assailant to be- begin his siege works at a greater distance from the place. Duguesclin in brusquely treating assault always, decided against the system of great fronts flanked only by widely spaled towers, the turrets were strong enough to prevent vigorous scaling; thus this was renounced about the end of the 14 th century to return to closer towers, and especially to increase greatly the relief of the curtains. Let us then examine these watch turrets of the papal walls at Avignon.

Fig. 8 presents the plan of one of those turrets below the machicolations' they consist only of two external buttresses A, between which is built a batter, whose utility we shall r recognize: an arch connects these two buttresses. Here (9) at A is the external elevation of this work and at B its section. The turret rises much above the curtain: like that at its top it is equipped with fine machicilations of stone on its front and its two sides; further, as shown by the section, at the right of the wall forming the back between the buttresses is arranged a second machicolation C, like a slot about 10 ins. wide. If the assailant presented himself before the turret, he received vertically the projectiles cast through the visible machicolations D, and obliquely those dropped through t the second masked machicolations C; for one will observe that, due to the slope E, the stone balls dropped from this second

macnicolation must nebessarily rebound on that slope F, and strike the assailants at a certain distance from the foot of the turret at the bottom of the ditch. The two buttresses, t the space between them and the slope were then a defense by rebourd, arranged to firce the assailant to withdraw from the foot of the rampart, and so receding, to present himself to the shots of the crossbow men occupying the covered way of t the curtain. These turrets flank the curtains, as shown by t the upper plans (10, 10 bis). They also permit a small post t to keep under cover inside beneath the gallery G, and to appe-ar instantly on the upper covered way H at the first call of the sentinel.

Note 1.p.125. The plan 10 is taken at the level of the parapet of the covered way of the curtain; plan 10 bis is at the parapet of the wooth turret.

The internal perspective view (11) illustrates the arrangement of the little covered post, that intercept's the passage at the level of the covered way of the curtain; it explains the steps ascending to the platform of the turret, and gives an account of the construction of the work. Let us not forget to mention the presence of the corbels A placed thus in the interior of the rampart to receive a beam supporting the jois-ts of the floor, whose other side rested on inside posts, in order to increase the width of the covered way in time of war, either to facilitate communication or to place projectiles or establish machines. We have explained elsewhere the utility of these additional covered ways. (Art. Architecture Militaire. Figs. 32, 33).

This sort of watch turret interrupting a passage on the curtains, like the touers had the advantage of obliging the rounds to have themselves recognized, either by the sentinel pla-ced at the top of the work or by the post sheltered beneath the little upper platform. Sometimes even these turrets were closed, completely barring the covered way, and they are actual guard rooms. We still see a turret of this kind on the western curtain of the fortress of Villeneuve-les-Avignon. This turret does not flank the curtain, and scarcely proje-cts beyond its external surface, it is reserved for the service of the garrison. Here is its plan (12). At A is the cove-red way interrupted by the turret and its two doors B; a sin-

single opening C has a view of the exterior; at D is a small fireplace. Two or three men at most could remain in this post presented here (13) in its internal appearance, assuming the roof sketched at E to be removed. This part of the walls of the citadel of Villeneuve-les-Avignon dates from the first h half of the 14 th century.

The forms given to watch turrets during the 14 th and 15 th centuries are much varied; when they serve for flanking, they are rectangular like those of Avignon, semicircular or polygonal, supported on buttresses, on corbelling or corbels, according to the need or the nature of the defenses; they are covered or uncovered, containing one or several stories of openings, with or without machicolations.

There still existed in 1835 at the top of the ramparts of t the abbey of Mt. S. Michel-en-Mer, at the south side, a beautiful turret with machicolations on the front and sides, like that of Villeneuve-les-Avignon, interrupting communication on the covered way of the curtain. That turret belonged to the structures of the 14 th century.[1]

Note 1.p.128. Since that epoch, the portion of the rampart in question has been restored and the turret was destroyed; long since it served as privies.

The plan (14) taken at the level of the openings shows the two openings closing the turret, the little fireplace that s served to warm the watch, the opening of the front machicolations at A, and those of the side at B. These machicolations were closed by means of h nged flaps.

Fig. 15 gives an external perspective view of this post with its roof. This structure was of red granite.

Fig. 15 bis presents at A the section of the turret on the line F G, and at B on the line C D of the plan.

In the first of these sections is indicated the opening of the front macnicolation at H with the projection K from the face of the wall to prevent arrows shot from below from sliding along the surface to the defenders. In the second section B is seen the opening of the front machicolation at L, and at M. Those of the side machicolations with the stops O for arrows coming from outside. These lateral machicolations with t the slots P served to flank the curtains, for one will note that the defenders could not only drop stones vertically, but

also shoot crossbow bolts obliquely, as indicated by the dotted line M N. One finds quite frequently in our ancient fortresses many turrets arranged in this manner, at least for front machicolations, but one should not take for them the privies that have the same appearance externally, and discharge o outside (Art. Latrine), when that exterior is a ditch or precipice.

As we shall have occasion to state many times in this Dictionary, the architects of the 13 th, 14 th and 15 th centuries always employed corbellings when this system of construction could be useful to them; it often happens in structures, that one is obliged to give the upper parts more area than the lower part of the masonry. The architects of the middle ages were subject to these requirements, they did not hesitate to e employ the system of corbelling, and they skilfully evaded t the resulting difficulties, while obtaining perfectly stable structures.

On one of the fronts of the castle of Vez (see general plan of the castle in Art. Donjon, Fig. 45), there exist still beautiful semicircular flanking turrets, of which we give an e external perspective view (16). On the batter of the curtain starts a buttress, rectangular and slightly projecting, that by means of three little corbels bears a lower semicircular cylinder on which are placed four moulded courses forming a strong corbelling, that supports the turret. The overhang of that mass is perfectly maintained by the mass of the curtain. On the other front of the same enclosure, inside the court of castle exist turrets here rectangular with double flankings, i.e., forming two projections at each side (17), intended to flank the curtain at right and left: the first projection is sufficiently great to allow shooting parallel to the surface of that curtain: the second is less but sufficient for oblique fire, as indicated by the plan A. Here again is a wide r rectangular buttress starting from the lower batter and separating the corbelling of the first projection, then the second buttress itself corbelled and bearing the offset of the second projection. Drips protect the mouldings and prevent rain from running down the surfaces.

In military architecture watch turrets were abandoned only after Vauban. They were regarded as useful, even with artillery,

during the 16 th and 17 th centuries; the projecting angles of bastions still bore turrets for two hundred years, only intended to shelter the sentinels. It is unnecessary to state that in case of siege this was the first thing battered by the assailants. This persistence of the watch turret only proved its importance in the military works of the middle ages, since it was so difficult to abandon it, even after the entire system of defense was transformed. The last watch turrets are in the form of pepper boxes, very narrow and borne on a corbel and having only the value of a watch box, i.e., only good for watching the outside, but not serving for defense. Yet at the beginning of the 16 th century, and at the moment when men already established covered ramparts outside the ancient enclosures, when these bulwarks present a salient angle (which is rare, the circular form being then accepted), this salient angle is sometimes furnished with a quite large turret, set diagonally on the angle of the rampart, as indicated by Fig. 18. These turrets could receive a falconet; they were ordinarily roofed by stone slabs placed on a vault, decorated by he heraldic shields and other ornaments, that gave to the salients of the ramparts a certain monumental appearance. Time and balls have left few traces of these little works, that we find only in old engravings; we scarcely perceive now on our old French bastions only some courses of corbellings, which supported this sort of turrets.

On the ramparts of earth and wickerwork, great use of which was made during the wars of the 16 th century to cover old fortifications, watch boxes of wood were established outside the salient angle of the bastion and at the middle of curtains (18 bis), so as to permit sentinels to see what occurred at the bottom of the ditches. This sort of watch box was employed untel in the 17 th century.

Men also established temporary wooden turrets on the defensive galleries of fortifications of the middle ages; these tu turrets were connected to the defensive galleries and formed a kind of bay.(Art. Bretecne). As for permanent wooden watch turrets, we have scrupulously destroyed them in France. Hardly may we perceive their traces on some towers. To find this sort of work still entire, it is necessary to decide to pass the Rhine and travel over conservative Germany.

On the eastery border of Lake Constance is a charming little city named Lindau; it is at the end of a Bavarian railway. Lindau has respected its mediaeval walls with some old flanking towers. One of these towers, whose construction dates in the 14 th century, is crowned by four wooden turrets of the 15 th century resting on stone corbels. Here (19) is that entire structure. The roofs are covered by glazed tiles with b balls and weathercocks of gilded copper. Since the 15 th century no profane hand has touched that innocent defense except to maintain it; no municipal council has claimed that the wood of the roof was decayed, or that the tower obstructed pedestrians. We give (20) the detail of one of these four turrets, whose wooden framework is paneled with masonry, with slots on each face. It suffices to cast the eyes on the engravings of Israel Sylvestre, Merian and Chastillon, to prove that all c cities of the North and East contained numbers of these towers crowned by watch turrets, that outlined themselves so well a against the sky, to give the cities a picturesque appearance. Today we are reduced to admire these remains of the past in ? Germany, Belgium or in England.

In the country and especially in the plain country, the roofs of the towers of castles were furnished wit turrets, that allowed one to see what occurred afar. Picardy and Flanders surmounted the roofs of their keeps by wooden watch turrets covered with lead or slates. The engravings have preserved to us some of these wooden watch boxes. We give here (21) one of them at A.[1] At the base of the gable are seen two other stone turrets B in two stories, flanking the covered way of the machicolations.

Note 1.p.138. From the castle of EBesel in Brabant. (Castello et praetorio ect. Antwerp. 1698.

We again find the tradition of these turrets crowning the roofs of towers in most chateaus of the Renaissance at Chambord, Tanlay, Ancy-le-France, and later at the chateau of Richelieu in Poitou, Blerancourt in Picardy, etc. It was only under the reign of Louis XIV, and when the steep roofs were no longer placed on the public or private buildings, that there disappeared the last remains of the watch towers of the feudal castles.

Roofs of city belfries were often furnished with wooden turrets. Like the roofs of keeps, men took great care to destroy

them with us and it is necessary for us to have recourse always to old engravings, if we desire to obtain an idea of their arrangement. Most belfry towers of cities of northern France were square, erected in the 13 th and 14 th centuries;[1] they were terminated by a gallery, covered or open to the sky, with turrets at the angles; further, the carpentry roof, generally very high and ornate (for the cities attached a sort of glory to the possession of a magnificent belfry), was pierced by lanterns or turrets, serving as boxes for the watchmen. It is indeed again necessary to borrow from the country beyond the Rhine, to assist our descriptions of these monuments. Let us then return to Prague, the city of watch turrets, whose G Gothic architecture most nearly approaches our school of Picardy.

Note 1.p.138. The belfries of Amiens, Bethune and Valenciennes, that exist now or existed a few years since, are built on a square plan. (Art. Beffroi).

The parish church located opposite the city hall possesses two towers on its western facade, whose tops rather assume the form of our municipal belfries of the north than that of a c church tower. These towers in the lack of other existing data, will serve us in restoring the watch turrets of the city halls of the 14 th and 15 th centuries.

On a last square story (22) expands a wide corbelling decorated by shields of arms, at the four angles this corbelling forms portions of an octagon, as indicated by the plan A. A stone balustrade extends around it and is surmounted at the angles by turrets also of stone and covered by acute pyramidal roofs of wood. Recessed and on the internal surface of the tower rises a great roof with eight sides, on four of which are placed wooden watch turrets also covered by octagonal pyramids. All these roofs are covered by slates and lead, with rods, balls and weathercocks. Four little diagonal roofs allow one to pass under cover from the base of the carpentry into each angle turret.

Fig. 23 gives the detail of one of the four upper turrets of the roof. A crown of this kind, but probably more sumptuous, must have terminated the belfry of the city of Amiens, built about 1440 and burned in 1562. A watchman had charge of the t top of this belfry, to sound the bells to announce the banishment of some criminal, fires that appeared in the city or sub-

suburbs, to give the alarm if he saw a troop of men at arms advancing toward the city, and to warn the sentinels placed at the gates. The different sounds of the ringing of the bells informed the inhabitants of the motive for which they were called. That watchman in the 15 th century received as pay o one crown of forty sous per year, and a coat of cloth half red and half blue, that he wore because of the"great winds and f frost in the said high belfry." He lodged in the tower, must play his "little pipe" at the morning ringing; he blew a horn to announce to the citizens assembled outside the city on the occasion of some ceremony or festival, that they could be at peace, and that nothing injurious occurred within the city. It was necessary for him to play certain airs when processions circulated in the city.[1] One will agree, that he was a man that earned well the crown of forty sous ($1) and a red and blue c coat per year.

Note 1.p.141. Desc. du boffroi de l'hotel de ville d'Amiens, by M. Dusevel. Amiens. 1847.

Certain monasteries and certain churches were fortified during the middle ages, and these churches being usually surrounded by buttresses, on these were placed the watch turrets. One may yet see on the western facade of the abbey church of S. Denis traces of circular watch turrets built in the 15 th century on the buttresses of the 12 th. During the wars with the English under Charles VI and Charles VII in Normandy, on the frontiers of Brittany and on the banks of the Loire, many abbey churches were thus equipped with watch turrets. In the provinces exposed to the raids of adventurers, in mountains and desert places, the churches were almost always rebuilt externally so as to be able to defend themselves from a troop of brigands. The turrets then served not only for posting watchmen by day and by night, but they also flanked the walls and commanded the approaches. The abbey church of S. Claude i in the Jura, now a cathedral, built toward the end of the 14 th century, bears on its buttresses turrets well enclosed and commanding perfectly the outside. These turrets (24) are one story and covered on the side buttresses, two stories (25) on the angle buttresses. One passes from one of these stories to the other by a trap placed in the floor and a little miller's ladder. In the south of France one notes on Romanesque churches

turrets built in haste in the 14 th century to put these edifices in condition to resist raids of the troops of the Black Prince. men also built turrets on religious edifices to receive small guns.

From the day that everyone no longer thought of his personal defense, the watch turret disappeared from our civil or religious edifices, and it must be recognized that the police of our times replaces with advantage those little posts of oversight.

ECHELLE. Scale. Proportion.

We do not speak of the ladder (echelle) used by workmen to ascend on scaffolds, nor of the permanent ladders on places reserved for executions, to which were fastened persons convicted of perjury or of some shameful crime, to leave them thus exposed to the sorry jokes of the crown.[1] We only occupy ourselves with the relative scale. In architecture one says of t the scale of a monument. "That edifice is out of scale." The scale of a dog is the dog, i.e., that it is proper for that h hut to be in proportion to the animal it is to contain. A dog hut into which an ass could enter and lie down would not be in scale.

Note 1.p.143. See the curious relief found at the base of t the south portal of Notre Dame of Paris, which represents a student fastened to a ladder; other students surround and seem to scoff at him. On the breast of the criminal is fixed a small square tablet on which are inscribed the letters P.FAUS. S for perjury.

This principle that appears so natural and so simple at first sight, is however one of those on which the different schools of architecture (of our time) understand least. We have already touched on this question in Art. Architecture, and o our lamented colleague, M. Lassus, had treated it before us.[2] Yet in practice, it does not appear that observations previously made on this subject have produced results. We have not the vanity to be surprised at this; we simply believe that o our explanations have neither been sufficiently extended nor clear enough. It is necessary to resume the question and to treat it thoroughly, for it is worth the trouble.

Note 2.p.143. Ann. arch. of M.Didron. Vol.1.

The Greeks in their architecture adopted the module, which cannot be doubted; they do not seem to have had scale. Thus whether a Greek order had 16.4 or 32.8 ft. in height, the harmonic rations are the same in one as in the other, i.e., for example, that if the diameter of the column at the base is o one, the height of the column will be six, and the intercolumniation one and a half at the middle of the shaft, in the small as in the large order. In a word, the dimension does not change the relative proportions of the different members of the order. Yet the Greeks were provided with a sense so delicate, that one can scarcely admit in them the nonapplication of a true principle in the matter of art, without a major cause. We are ignorant of the harmonic mechanism of Grecian architecture; we can only state its results without having so far discovered its formulas. We indeed recognize, that there exists a module, different tonalities, mathematical rules, but we do not possess the key, and Vitruvius can aid us little in this, for he himself does not seem to have been initiated into the formulas of Grecian architecture of the best time, a and what he has said on the subject of the orders is not in accord with the examples left by his masters. Let us then leave this problem to be solved, observing only the appearance. If we consider only the two architectures, mothers of the arts of the middle ages, i.e., Grecian and Roman architectures, we find in the former a complete art, all in one piece, consistent, formulated, in which the appearance is in accord with t the principle; in the second a construction often independent of the appearance, the need and the art, the object and its decoration. The need being manifested in Roman architecture, being imperious even habitually, and the need relating to man, the pure harmony of Greek art is destroyed; scale already appears in Roman edifices; it becomes imperious in architecture of the middle ages. Likewise in antique society the individual is nothing, only the sport of destiny, lost in public affairs, so that he cannot exert an influence on the form or proportions of the monuments that he erects. A temple is a temple; it is great, if the city can make it great; it is small, if its purpose or penury of resources requires it to be small; if it be great, there is a great doorway; if it be small, there is only a little doorway. Impossibilities resulting from

the nature of the materials alone place a limit to the dimensions of the great monument, just as the necessity of passing through a doorway alone prevents it from being below the human height; but it certainly did not occur to the mind of a Greek to place his edifice in relation with himself as a man, than to suppose that his will could modify the decrees of destiny. The harmonic relations existing between the members of a Grecian order are so fully determined by the art and not th the object, for example, a portico of Doric columns having a always to be erected on a platform composed of courses receding behind each other like steps, the height of these steps having to be in harmonic relation to the diameter of the columns, id the diameter of these columns be such, that each step has the height of an ordinary rise, it is so much the better for the legs of those desiring to enter beneath the portico. but if the diameter of these columns is much greater the harmonic height of the step will increase in proportion; it will become impossible for human legs to clear them, and since after all it is necessary to ascend, men made in even these courses steps at certain points, as a concession made by art to human needs, but made with regret, as one perceives. Evidently the Greek regarded art matters rather as a lover than as a master. With him architecture only obeyed its own laws. That is certainly very fine, but it can only exist in the midst of society like Greek society, in which culture, respect, love and the preservation od the beautiful were the principal matters. We must either return to those favorable times, or make our edifices at a scale. Besides it is unnecessary to hope to be able at the same time to sacrifice to these two opposed p principles. When in a city the public and private edifices a are all erected according to a proper harmony, belonging to the architecture itself, there is established between these works of very different dimensions and relations, that probably give to the eyes pleasure, that a well written symphony g gives to the hearing. The eye easily neglects the dimensions when the proportions are the same, and one conceives very well, that a Greek would experience as much pleasure in seeing a l little order established according to harmonic rules , as a great one; that he would not be shocked by seeing the little and the great besied each other, than one is shocked by hearing

a melody sung by a soprano and a baritone. Perhaps even the Greeks established in relations between the dimensions the harmonic relateons, that we recognize between voices an octave apart. May the monuments intended to be seen together have been composed by antiphonies? We can well believe that the Gr Greeks were capable of anything in the matter of art, that th they experienced by the sense of sight enjoyments, that we a are too rude to ever know.

The Greek method was lost, and the Romans did not comprehend it. Instead of those harmonic principles based on the abstract modules, the middle ages put forth another principle, that of scale, i.e., than in place of the module varying according to the dimensions of edifices, it takes a uniform measure, and that uniform measure is first given by the height of man, then by the nature of the material employed. These new principles (we say new, for we see them applied nowhere in antiquity), do not cause, that because man is small, all monuments will be small; they are limited, even in the most immense edifices, (and the middle ages did not commit the fault of erecting such), to compel the architect to recall always the dimensions of man, to take into account always the dimensions of the materials that he employs.

Henceforth a doorway will not increase in proportion to the edifice, for the door is made for man, it will retain the scale of its purpose; a step will always be a practicable riser. The height of man (it is well understood, that we select among the smaller) is divided into six parts, which are divided into twelve, for the duodecimal system, which is divisible into halves, fourths and thirds, is first accepted as the most complete. Man is a fathom, the sixth of man is the foot, the twelfth of a foor is the inch. Provided with that measure, the architects proceed to subordinate to it all the members of their edifices; then man becomes the module, and this module is invariable. That does not mean that the architecture of the middle ages, at its origin and its climax may be a simple calculation, a numerical formula; no, this principle is limited to recalling always the human height. Thus whatever be the he height of a pier, the base of that pier never exceeds the height of the window sill; whatever the height of the facade, t the height of the doorways will not exceed two fathoms, or t

two and a half at most, because one does not suppose that men and what they can carry, such as banners, canopies, rods, could exceed that height. Whatever the height of the nave, the service galleries with different stories will be proportioned, not to the size of the edofice, but to the height of man. Now for certain principal members. Let us enter further into the theory. Men have been very far to seek the origin of engaged columns, which in monuments of the middle ages extend indefinitely, whatever their diameter, contrary to the Greek system; yet there was need only to refer to the principle of the scale adopted by the architects of those times to find the reason of that innovation. men have denied to us the influence of the human scale, saying to us for example, that the engaged columns of the piers of the cathedral of Rheims are much larger than those of a village church; we reply that the engaged columns of the cathedral of Rheims are not in proportional relation wit the engaged columns of an edifice of one fourth the size. That is a matter of geometry.

Let us take a monument frankly Gothic, the principal nave of the cathedral of Amiens. That nave is 47.6 ft. between axes of piers; the central columns are 4.5 ft. diameter, and t the four little columns engaged to the central column are 1.5 ft. We demand that there be indicated to us a nave of the same epoch with only 23.8 ft. between axes, whose central columns are only 2.2 ft. diameter with engaged columns 0.7 ft., i.e., being in exact ratio to the proportions of the nave of the c cathedral of Amiens.

Here is a monument that presents itself opportunely, constructed of very resistant materials, while those composing the c cathedral of Amiens are but moderately so; this is the nave of the church of Semur-in-Auxois, built at the same time as t that of the cathedral of Amiens. The nave has a width of 20.6 ft, . little less than half the former. Now the central columns are 3.5 ft. diameter, the columns engaged to them are 0.8 ft. instead of 2.1 and 0.6 ft. Those proportional ratios found in antique architecture then do not exist here; note that 0.105 makes just 17.7 ins, and 0.27 is 10.6 ins, and the little columns engaged to the piers of the church of Semur-in-Auxois a are the slenderest of that epoch known to us; ordinarily the little columns, that have such great importance because they

apparently support the principal members of the architecture in the sammlest edifices are 1.05 ft, in the largest 1.31 ft.; in the exceptional one at Rheims, 1.6 ft.;[1] i.e., 1, $1 + \frac{1}{4}$, $1 + \frac{1}{2}$. But what gives the scale of an edifice are rather measures in height than measures in width. Now in that little church of Semur, the level of the top of the bases is 3.5 ft. above the floor, and these piers are only 16.4 ft. high including the capital, to the impost of the vaults of the side a aisles. In the cathedral of Amiens, the piers that fulfil the smae purpose are 45.3 ft., and the level of the top of the bases is 3.5 ft. high. In the cathedral of Rheims, the piers a are 36.7 ft. high, and the bases are 4.3 ft.; i.e., $3\frac{1}{4}$ and 4 units. The capitals of these piers of the nawe of Amiens including everything are 3.7 ft. high; those of Rheims are 3.7 ft.; those of the little church of Semur are 3.1 ft., same as the bases. The nave of the cathedral of Rheims is 121.4 ft. under the crown; the little columns of its triforium are 11.5 ft. high. The nave of the cathedral of Amiens is 137.8 ft. beneath the crown, the columns of its triforium are 9.8 ft. high. The nave of the church of Semur is 78.7 ft. under the crown; the little columns of its triforium are 6.6 ft. high; that is the minimum, since the triforium is a serwice passage, which indicates the presence of man; thus it does not increase in proportion to the dimensions of the edefice. On the contrary even when as at Amiens the construction compels the architects to give the triforium a greater height beneath its ceiling, they recall the human dimensions by an important and very visible detail, such as the little columns. It is for that, that at the base of edifices, in the interiors and below the great windows, the architects take care to attach arcades, whatever the dimensions of the edifices, which are not only borne by little columns of 6.6 ft. height at most, little columns that are thus entirely around the monument at the height of the e eye, as multiplied means of recalling the human scale, and th that in a most striking fashion, that these columns always r rest on a bench, which is well understood to be made as a seat, and only has a height suitable for that purpose, i.e., from 15.7 to 17.7 ins. It is unnecessary to state that balustrades and window sills, whatever the dimensions of the edifices, ha have only the necessary height, i.e., 3.3 ft.

Note 1.p.147. In the architecture of Champagne of the 13 th century, the columns are of much greater diameter, then in t the school of Ile-de-France. The most slender are found in t the Burgundian school, and that is by the extraordinary resistance of the materials of that province.

Not only the height of man, but also the dimensions of the materials determine the scale of Roman, and particularly that of Gothic architecture. Every architectural member must be c cut in the height of one course; but since building stones do not everywhere have the same height of bed, that is where is recognized the flexibility of the principles of this architecture. With a tact and art feeling very little appreciated in our days, the architect of the middle ages built his construction so as to place it in accord with the dimensions of the edifice that he erected. It matters little that the materials are high or low, he knows how at the same time to submit himself to the scale imposed by these materials anf to the proportions suitable for a great or a little monument. Let us assume that he possesses only limestones with height of bed of 1.3 ft. at most, and that he desires to build an edifice of very great dimensions, for example like the cathedral of Paris; let us even admit that he holds to giving this facade grand proportions, or better said, a scale superior to the common scale; He will build the substructures in regular low courses; if in these substructures he desiers to have bands project, he will only give these bands a small height, and again he will cut on them fine and deficate mouldings, to leave to the lower mass all its importance' he will maintain the horizontal lines as better indicating the stability. Reaching a certain height, he feels it necessary to avoid the uniformity suited to a substructure, that the horizontal beds produced by the courses will destroy the effect of the vertical lines. T Then before that constructiou comoosed of courses he places l little columns set on end, whimh are like an architectured design independent of the construction; he places on these little columns arches cut in stones likewise set on edge, and bonded to that one does not perceive the structural joints, t thus he gives to his architecture the proportions that suit him, and he leaves to these proportions the more grandeur, in that behind this ornamental facing the eye recovers the true

scale of the structure, that given by the dimensions of the materials. The great open gallery, that below the towers terminates the facade of Notre Dame of Paris, is a masterpiece of that kind. The true construction, like an unvarying theme, continues from top to bottom by regular courses of about 1.3 ft. high. Before the uniform mass is first placed the gallery of the kings with its monolithic columns 9.8 ins. diameter, placed between statues 9.8 ft. high. Then comes immediately a balustrade at the human scale, i.e., about 3.3 ft. high, which restores to the gallery its grandeur by recalling the height of a man near those colossal figures. Above are horizontal courses, the theme continues with nothing to change the effect. The work terminates with that great vertical gallery, whose monolithic columns are 16.7 ft. high and 7.0 ins. diameter, crowned by arches and a projecting cornice, high and strong, in which however the ornamentation and the mouldings are subject to the dimensions of the materials. (Art. Corniche, Fig. 17). The towers rise on that vast substructure; as all know, they are composed of piers with little engaged columns built in courses 1.5 ft. high; but so that the eye at that distance can see the construction, there is an enormous pile of courses at the angles, each of these courses bearing a crocket and outlined against the wall or the sky. Those long series of crockets thus mark the scale of the construction, and restore to the towers their actual dimensions by showing how many courses compose them. On the facade of Notre Dame of Paris, the scale given by the height of a man and by the nature of the materials is then carefully observed from base to ridge. The statuary serves as a point for comparison, but doors exist only in the lower parts; the upper ones are without it, and the architect has proceeded wisely; for on an edifice of this height, if one places statues at the top, they will appear too small, when they do not exceed at least twice the height of man; they crush the architecture when they are colossal.

On entering a church or a Gothic hall, each one is disposed to believe these interiors much greater than they actually are; it is again by a judicious application of this principle of the human scale, that this result is obtained. As we have just stated, the bases of piers, their capitals, the little columns of the upper galleries recall at different heights

the stature of man, whatever are the proportions of the monument. Further, the multiplicity of the vertical lines singularly adds to the height. In these interiors the mouldings are flat and delicate, always cut in courses lower than those of the piers or walls. The spaces in the tracery of the windows never exceed the width of an ordinary opening, say at most 4.1 ft. If the windows are very wide, the mullions are multiplied and always recall these dimensions to which the eye is accustomed, and cause in effect that these wiydows have their actual width. Besides these openings are filled with glass panels separated by iron bars, which agin contribute to give the glaaed openings their true size; and to return to the indefinitely elongated engaged columns, in the use of which some see a decadence or rather a forgetting of the rules of antiquity for the orders, others the influence of a foreign art, and s still others the product of chance, they are only the result of a principle, that has no relation to the principles of antique architecture. First it is necessary to admit that the Greek orders exist no longer, because in fact they have no r reason to exist among a people, that entirely abandons the l lintel for the arch. The lintel being no longer accepted, the point of support is no longer a column but a pier. The column supporteng a lintel is and should be diminished, i.e., should present at its base a wider section than at its capital; this ir first a need of the eye and also a law of statics; for the lintel being an inert body, it is necessary for the support on which this weight rests should present a perfect stability. On the contrary the arch is an active load, that can only be maintained by an opposing force. Four arches rest on a pier and reciprocally abut each other, and the pier is only a resistance opposed to the resultant of these opposed forces. It w will never come into the mind of an architect (we mean an architect that constructs) to place four arches on a conical or pyramidal pier. He will turn them from a cylinder or prism, since he knows that the resultant of the oblique pressures of these four arches, if equal in diameter, depth and loading, n passes along the axis of this prism without deviation. He can content himself with a pointed strut set on its point to carry these arches. Now as we have sufficiently emphasized in Art. Construction, the system of vaults and of arches adopted in

the middle ages being nothing but a system of equilibrium of forces opposed to each other by abutments or loads, all in that system of architecture tends to resolve itself into vertical pressures, and the system of equilibrium being adopted, since it is necessary to foresee everything and even imperfection in execution, since it is necessary to count on errors in the estimation of the oblique pressures or loads, and consequently on deviations in the vertical resultants, better in that case is a pier lending itself to those deviations, than a pier inflexible on its base. Indeed let a pier A (1) then be the resultant of the pressures, which instead of being perfectly vertical may be oblique according to the line C D, and this resultant will tend to give place to the pier the movement indicated at B. Then the pier will be flushed at its edges. But on the contrary if on a pier E be an oblique resultant of pressures, the pier will tend to rock on its base so that this resultant will return to the vertical as proved by the sketch F. Then if the pier be loaded, this covement can have no serious inconvenience. All can make this experiment with a cone on the vertex on the base of which is placed the finger. In the first case the base will be moved from the horizontal plane; in the second the cone will follow, and unless the centre of gravity leaves the conical surface, one will f feel under the pressure a resistance always sufficiently strong. So let us leave then the proportions of the locumn of t the antique orders, which have nothing to do with the system of construction of the architecture of the middle ages. Let us compare opposed methods by their similar principles. The Gothic and even the Romanesque architects of the north did not k know the column, properly speaking, they knew only the pier. When the architecture perfected itself, that pier was decomposed into as many members as there were arches to support; certainly nothing is more logical. These members have to receive equal members or nearly so; then by reason of the extent of t the monuments, they give to each one the proper diameter, 1.05, 1.31 or 1.60 ft., as we have proved above; that is also very logical. They placed these combined members on a single base, not made for them but for man, just as the doors, balustrades, steps and window sills, are made for man and not for monuments; that does not conform to the antique system, but it is still

according to logic, for these are not edifices that enter their own doors, ascend their own steps, or lean on their own balustrades, but indeed men do so. These members or parts of piers, these supports have, one an arch support 16.4 ft. above the ground; it is stopped at that height and its capital is set (which is merely a corbel proper to receive the impost of the arch) (Art. chapiteau); another must carry its arch at 26.3 ft. above the ground; in its turn it stops at that level; the last will receive its load at 49.2 ft., and its capital will be placed at that height. That is neither Greek nor even Roman, but it is always perfectly logical. The engaged Gothic column, which is thus lengthened or shortened according to t the height of the load it must carry, has no moduce, but it has its scale, which is its diameter; it is cylindrical and not conical, because it indicates only a support receiving a load acting on its axis, and that assuming even a deviation in the resultant of the pressures, it is less dangerous to the stability of the edifice, that it can incline as a post would do, than if it had a large bearing opposing that movement. Its diameter isas little variable as possible, whatever the dimensions of the edifice, because thes uniform diameter, to which the eye accustoms itself, appearing slender in a vast monument and large in a little one, thus indicates the actual dimension, and serves as a scale, in a word, like the bases, arcades, b balustrades, etc.

But since the architects of the middle ages have the manifest desire to make the interiors of monuments seem great (which is not an evil), they carefully avoid all that could injure that greatness. Thus they avoid placing statues in these interiors, unless in the lower parts, and then they only give them human dimensions at most. The idea of placing colossal figures beneath a vault or ceiling never came in their minds, because they were architects, they loved architecture and did not allow the other arts to destroy the effect it should produce. Sculptors were no longer unfortunate or less skilful in making statuary to the scale; they found their account in it, and architecture cound its own. (Art. Statuaire).

How from a point of departure so true and logical, so according to the invariable principles of all art; how from that e exquisite sense of the artist subjecting himself to a rigoro-

rigorous law without weakening the expression of his personal genius, man came to erect in a city, a centre of refined and intelligent schools, a monument like the arch of triumph of the star, i.e., out of scale with all surrounding it, a portal through which would pass a frigate with its masts, a monument whose principal merit is to make the grandest promenade in Eu-Europe appear a thicket of shrubs; it must be that the sense of sight has been strangely falsified among us, and that by a long series of abuses in the matter of art, we have lost all feeling for the true. Already more than a century since, president De Brosses,[1] speaking of his first visit to the basilica of S. Peter of Rome, says that in the interior that vast edifice neither seemed to him gread nor small, high or low, wide or narrow. He adds; "one perceives its enormous extent only by proportion, when one considers a chapel it is found as great as a cathedral; in measuring a grotesque figure there at the foot of the column; one finds a thumb as large as the wrist. That admirable edifice by the admirable correctness of its proportions has the property of reducing colossal things to their proper value. What a happy property!" To erect colossal edifices so that they may appear only of ordinary dimensions, to make statues of infants 9.3 ft. high seem to be of ordinary size! Yet president De Brosses is a man of sense, very intelligent and art-loving; his letters are full of very correct appreciations. It is because that since him has been repeated that judgment of the terrible amateur, making a bad compliment to S. Peter of Rome. One could say as much of our arch of triumph of the star and of some other modern monuments; "The arch of the star by the admirable correctness of its proportions, only appears like an ordinary gateway; it has the property of reducing all around it to such small dimensions, that the avenue of the Champs Elysees seems to be a path bordered by hedges, and the carriages traversing it are ants passing about their affairs along a line of sand." If this be the aim of art, Mt. Blanc is the despair of architects, for they will never s succeed in erecting an edifice, that has that degree of merit to reduce to nothing all that surrounds it. In the city where we exert ourselves to erect public buildings, that recall in nothing the human scale, open windows so out of proportion to the services they are intended to light, which it is necessary

to cut into two or foud parts by floors and partitions, so t that the rooms receive light as indicated by the adjacent illustration (2), which is neither beautiful nor convenient, w when we crown our cornices of these edifices by dormers with which one would make a facade suitable for habitation: in that same city, let us say, are imposed on us (and the council mav be praised for it!) dimensions for heights of our houses and of their stories. The reason of the public desires men to restrict themselves within the limits imposed by good sense and salubrity, when this cincerns private edifices. Here is what is no longer entirely according to logic, for the public edifices (or we are singularly mistaken) are made for men as well as houses, and we do not become twice or thrice as large when we enter them. Who then are these edifices out of scale with us, with our needs and our habits? That is more majestic, says one. But the facade of Notre Dame is sufficiently majestic, and it is at the scale of our human weakness, it is great and appears so, but the houses surrounding it are always houses and not cages for mice, because on the facade of Notre Dame, however great it is, the architects took care to recall from top to bottom that human scale, that lowest scale which we desire indeed, but of which we are not the authors.

Note 1.p.152. Lettres famillieres ecrites d'Italie en 1740, by C. De Brosses. Vol. 22. p. 3.

ECHIFFRE, MUR D'. Stair String Wall.

This is the wall on which rest the steps of a stairs, when this wall does not exceed the levels of the projecting steps. (Art. Escalier).

ECOLE. Style or School of Architecture.

During the middle ages there were on the area of France of our days several schools, either during the Romanesque epoch or in the Gothic period. The Romanesque schools mostly came from the monastic establishments, some like the Romanesque s school of Ile-de-Franc and Normandy, belonged to the political organization of those provinces; others like the schools of Provence and of a part of Languedoc, are only the expression of Roman municipilaties, which in those provinces continued until the epoch of the war of the Albigenses; these last

schools more than any other followed the traditions of antiq-
ue architecture. Others still like the schools of Perigord,
Saintonge, Angoumois and a part of Poitou, about the 11 th c
century suffered the influences of Byzantine art. In our pro-
vinces are only counted four schools during the Gothic period;
the school of Tle-de-France, Soissonais and Beauvoisois; the
school of Burgundy, the school of Champagne, and the Norman
school. (See for explanations, Arts. Architecture Religieuse,
Architecture Militaire, cathedrale, Clocher, Construction, E
Eglise, peinture, Sculpture, Statuaire).

ECU. Shield. (See Art. Armoires).

EGLISE PERSONIFIEE. Church personified.
SYNAGOGUE PERSONIFIEE. Synagogue personified.
About the beginning of the 13 th century, the constructors
of our catnedsals, conforming to the spirit of the time, des-
ired to trace on the portals of those great edifices both rel -
igious and civil, not only the history of the world, but eve-
rything connected with the creation and the knowledge of man,
his good and bad tendencies. (Art. Cathedrale). In carving on
the voussoirs of these portals and the vast recesses of these
doorways the scenes of the old and New Testaments, however t
they claimed to indicate to the multitude of believers the d
distinction to be established between the new and the old law;
that is why in a visible place on these facades they placed
two statues of women, one holding a standard that broke in her
hands, having a reversed crown at her feet, allowing tablets
to fall, bowing her head, the eyes covered by a band or by a
dragon coiled around her forehead; this is the ancient law, t
the synagogue, a dethroned queen whose glory is past, blinded
by the spirit of evil, or at least incapable of knowing the
eternal truths of the new law. The other statue of a woman w
wears a crown on her head with raised brow; her expression is
proud; she triumphs and turns to the side of the assembly of
the apostles, in the midst of which stands Christ teaching;
this is the new law, the Church. This beautiful programme was
fulfilled in the most complete manner on the portal of the c
cathedral of Paris. The statues of the Church and of the Syn-
agogue were still seen at the two sides of the principal portal

at the end of the last (13 th) century, in the wide niches c cut in the faces of the buttresses; the Church on the right, of Christ surrounded by the apostles. The Synagogue on the left.[1]

Note 1.p.154. These two statues were removed in Aug. 1792. They have just been replaced.

We now possess in France only a very small number of these statues. The church of S. Seurin of Bordeaux has retained its own, as well as the cathedrals of Strasburg and of Rheims. T The Church and the Synagogue are lacking among the statues of our great and truly French cathedrals, like Chartres, Amiens and Bourges; they onln exist at Paris and Rheims. One should observe in this case that the statues of the Church and of t the Synagogue, placed parallel and occupying very visible places, are only found in the cities where existed in the middle ages a numerous Jewish population. There were few or no Jews at Chartres, Bourges or Amiens; while at Paris, Rheims and Bordeaux, in the cities of the Rhine, in Germany, Jewish families were important and were often the object of persecutions. The lower part of the facade of Notre Dame of Paris having b been built under Philip August, an enemy of the Jews, it is not surprising that in that epoch it was desired to show the multitude the state of inferiority in which was held the old law. At Bordeaux, a city tolerably peopled by Jews in the 13 th century, the statuary artists that sculptured the fegures of the south portal of S. Seurin did not limit themselves to placind a band over the eyes of the Synagogue, they surrounded the head by a dragon (1), as the Parisian artists had done. The Synagogue of S. Seurin of Bordeaux has allowed her cross to fall at her feet; she holds only the staff of her standard and her tablets are reversed; to her girdle is attached a purse. Is this an emblem of the riches attributed to the Jews? At A is a detail of the head of this statue.

At the cathedral of Bamberg, whose statuary is so remarkable and recalls the good French schools of the 12 th and 13 th centuries more than any other in Germany, the representations of the Church and the Synagogue still exist at the two sides of the north portal; and a curious fact because perhaps connected with some political act of that epoch, although this p portal may be of the 12 th century, the two statues of the old

and new law are of about 1230; further they are accompanied by accessory figures, which give a more marked signification than elsewhere.

The Synagogue of the cathedral of Bamberg (2) stands on a column to which is attached a little figure of a Jew, easily recognized by his pointed cap.[1] Above that statue is a devil, whose legs are winged; he rests on the cap of the Jew. The s statue of the old law is beautiful, its eyes are covered by a cloth band; with the left hand it allows five tablets to drop, and with the right it holds with difficulty its broken standard. No crown is seen at its feet. As a pendant at the left of the specator and consequently on the right of the portal, the Church likewise stands on a little column, the lower part of whose base is occupied by a seated figure with a scroll displayed on its knees (3); with the right hand (now mutilated), this personage seems to bless, the head is wanting, which embarrasses us a little in designating that statue, which however we believe to be Christ. Above are four evangelists, i.e., below the lion and the ox, above the eagle and the angel, Unfortunately the two arms of the new law are broken. Further, one always recognizes that it held the standard with the right hand and the chalice in the left. This statue, beautifully e executed and full of nobility, nowise affected as are already the statues of that epoch in Germany, is crowned. It is covered by a canopy, like its pendant.

Note 1.p.155. No one is ignorant, that in the middle ages in cities the Jews were obliged to wear a cap of a particular form, much resembling a funnel or a reversed suspended lamp.

The cathedral of Strasburg still preserves at the side of i its south portal, which dates from the 12 th century, two statues of the Church and of the Synagogue sculptured about the middle of the 13 th century. Thus these representations sculptured on the portals of churches appear to have been made from 1210 to 1260, i.e., during the period particularly sad for t the Jews, when they were persecuted with the most energy in the West. The Synagogue of the cathedral of Strasburg that we give (4) has its eyes covered; its standard breaks in its hand; its left arm is pendent and allows the tablets to fall. The Church (5) is a gracious figure, almost smiling, sculptured with rare delicacy in that beautiful red sandstone of the Vos-

Vosges, which takes the color of bronze.

That manner of personifying the Christian religion and the Jewish religion is not the only one. We see over the south p portal of the cathedral of Worms, in the tympanum of the gable surmounting that portal a great figure of a crowned woman, holding the chalice in the right hand as one holds a vase into which is poured a liquid. That crowned woman (6) is proudly seated on an animal with four heads, eagle, lion, ox and man; four legs, a human foot, cloven hoof, lion's paw and e eagle's talon; that is again the new law. In the tympanum of the portal below that statue is seen the coronation of the Virgin; on the voussoirs are the nativity, Noah's rainbow, A Adam and Eve, the crucifixion, the three women at the tomb, Jesus Christ resuscitated, and the prophets. Among the statues of the jambs are noted the Church and the Synagogue. The Christian religion bears the raised standard and is crowned; the Jewish religion has bandaged eyes and is slaying a goat; her crown falls at one side, her tablets at the other.

We find the extended explanation of the statue seated on t the beast with four heads in the manuscripts of Herrade of La Landsberg, the Hortus deliciarum (garden of delights), now d deposited in the library of Strasburg.[1] One of the vignettes represents Christ on the cross. Above the two arms of the cross is seen the weeping sun and moon, then the torn veils of the temple. Below are two Romans, one holding the spear, the other the sponge filled with vinegar and gall; the Virgin, S. John and the two thieves. On the first plane at the right of the Saviour is a crowned woman, like that of the Cathedral of Worms, seated on the beast, a symbol of the four gospels; she holds a cup into which falls the blood of Christ; in the left hand she bears a standard ending in a cross. On the left of the divine execution is another woman, seated on an ass, whose feet stumble in knotted cords; the woman has nude legs; a veil falls over her eyes; her right hand holds a knife, her left hand drops the tablets; on her lap lies a goat, her standard is reversed. Below the representation the dead are leaving their tombs.

Note 1.p.159. This manuscript is a sort of encyclopedia; it dates from the 12 th century. Several of its miniatures have been reproduced by us in the Dictionnaire du Mobilier Francais.

Although the sculpture of Worms dates from the middle of the 13 th century, it gives us in statuary of a beautiful style a fragment of the scene so fully drawn in the 12 th century by Herrade of Landsberg, i.e., the Church collecting the blood of the Saviour and seated on the four gospels. The woman borne by a fettered ass personifies the Synagogue, this was to treat the Old Testament with some harshness.

Frequently in our France stained glass is likewise seen a Christ on the cross with the Church and the Synagogue beside him, but represented without their animals, the Church collecting the blood of the Saviour in a chalice, and the Synagogue veiled, averted like the statues of Bamberg and of Strasburg, or holding a young goat that she slays. Villard of Honnecourt appears in vignette 57 od his manuscript to have copied one of the figures of the Church on stained glass and perhaps a painting of his time.

EGLISE. Church. Basilica.

Place for assembly of believers. During the middle ages churches were divided into cathedral, abbey, monastic, collegiate and parish churches.

Parish churches are found under the jurisdiction of bishops or that of abbots; thus it was for them, bishops and abbots, to govern a considerable number of parishes; hence one of the first causes of the prodigious number of parish churches erected in cities and market towns during the 12 th and 13 th centuries, i.e., at the epoch of the commencing struggle between the monastic and the episcopal powers. Besides the division and antagonism exist in all religious or political institutions of the middle ages, each one in the civil as in the spiritual order desires to have a distinct part. The great abbeys from the 11 th century sought to place unity in the midst of this general subdivision; but it soon became evident that the monastic order established that unity for its own special advantage; the episcopate recognised if soon enough to profit by the municipal development of the 12 th century, and to attract the people toward itself, either in building immense cathedrals or in rebuilding the parish churches in larger proportions, especially in cities. Indeed if we pass through the cities of France north of the Loire, we see that not only all

the cathedrals, but also the parish churches, were rebuilt du during the period comprised between 1150 and 1250. This movement was originated by the episcopate and encouraged by the s secular nobility, which saw in the abbots too powerful feudal lords, and was pursued with ardor by the urban people, among whom the church was then a mark of independence and unity. Th Thus from the 12 th to the 13 th centuries money flowed for building those great cathedrals and the parish churches grouped around them.

The abbot of the Cluniacs had formed a school, i.e., parishes dependant on them imitated as far as possible those typical monuments, in more modest proportions. It was the same for the cathedrals, when they were rebuilt at the end of the 12 th and beginning of the 13 th centuries; they served as models for the parish churches erected in the diocese. Yet it is unnecessary to believe that these little monuments were reductions of the great ones; imitation wisely restricted itself to adopting the methods of construction, the arrangements in detail, the ornamentation of certain iconographic characters of the vast abbey churches or of the cathedrals.

About the 5 th century when the new worship could be practised publicly, two principles had a marked effect in the construction of the churches of the West, the tradition of the antique basilicas, which among pagan monuments first served as places of assembly for the faithful; then the memory of t the venerable sanctuaries excavated underground, crypts that had enclosed the remains of martyrs, and in which the sacred mysteries had been practised during the days of persecution. Nothing resembles the crypt less that a Roman basilica; yet the Roman basilica had at its end opposite the entrance a s semicircle covered by a half dome, the tribunal. There in the first Christian churches was established the seat of the bishop or of the ministering ecclesiastic, who replaced him, around him were ranged the clerics; the altar was placed in front, at the entrance of the semicircle raised several steps. The faithful stood in the aisles, the men at one side and the women at the other. Usually our first French churches possessed under the semicircle the apse, a crypt in which was deposited the sacred body, and sometimes the end of the church itself r recalls the arrangement of these subterranean structures, al-

although the nave retains the appearance of the antique basilica. these two kinds of such opposed construction left traces long in our churches, and the sanctuaries are vaulted, built according to the solid method of Roman edifices constructed of bricks and concrete, while the naves only consist of light walls resting on rows of piers with a covering of carpentry like the antique basilicas.

We posses only very vague information on the primitive churches on the soil of France, and it is from only the 10 th c century, that we can obtain a passably accurate idea of what those edifices were; again at that epoch they presented varieties according to the provinces within which they were erected. The primitive churches of Ile-de-France do not resemble those of Auvergne; the latter nowise recall the churches of Champagne, of Normandy or of Poitou. The religious monuments of Languedoc essentially differ from those erected in Burgundy. Each province during the Romanesque period possessed its school, the result of different traditions. The Latin influence at first appears everywhere; it changes more or less, according to whether these provinces place themselves in connection with the adjacent active centres of civilization, or find within themselves the new impulses. For example, Auvergne, th that for centuries passed for one of the most backward of the provinces of France, possessed in the 11 th century a very advanced are very complete, that allowed it to build beautiful and stable churches, still standing today. Champagne, of all French provinces excepting Provence that longest retained the Latin traditions, perhaps because its territory still contained in the first centuries of the middle ages a great number o of Roman edifices. It is the same with Soissonais. In the East near the coasts of the ocean, on the contrary, we find from t the 10 th century a marked Byzantine influence in the construction of religious edifices. That Byzantine influence appears in the East along the banks of the Rhine, but it assumes a d different appearance. Having occasion in this Dictionany many times to occupy ourselves with churches of the different parts entering into their construction (Arts. Abside, Architecture Religieuse, Cathedrale, Chapelle, Choeur, Clocher, Construction, Nef, Travee), we shall restrict ourselves to mentioning here the general characteristics, that can aid in classifying

churches by schools and by epochs.

FRENCH SCHOOL. One of the oldest churches of the French school, properly so called, is the Basse Oeuvre (lower work) of Beauvais, whose nave belongs to the 8 th or 9 th century. This nave is that of a Roman basilica with its side aisles. T It is composed of two walls pierced by windows with round arches, two rows of piers of square section supporting round archivolts and the upper walls likewise pierced by windows. This very simple structure was covered by visible carpentry. The a apse is now destroyed, and was probably composed of a semicircle covered by a half dome; did a transept exist? That is what we cannot say. As for the facade rebuilt in the 11 th century, it was apparently preceded originally by a portico or n narthex, according to the custom of the primitive churches. T The construction of this edifice is again evidently entirely Roman with walls of small rubble with squared faces and bands of bricks. No appearance of ornamentation, unless on the facade built later. It is unnecessary to see there the Franco-L Latin church in its rude simplicity. The walls must have been decorated in the interior by paintings, since the authors occupying themselves with the religious monuments of the Merovingians and Carlovingians, Gregory of Tours at the head, speak continually of the paintings that cowered the churches of their tome. The windows must have been closed by gratings of stone or wood in which were inserted pieces of glars or of gypsum. (Art. Fenetre). The ancient Beauvoisois still contains other churches nearly contemporaneous with the Basse Oeuvre, but smaller and without side aisles, composed only of a rectangular hall with a square or semicircular apse. These are actual barns. Such are the churches of Abbecourt, Auviller, Bailleral and Bresles.[1] Those churches were not vaulted but covered by visible carpentry. We see that tradition persists untel about the beginning of the 12 th century. The naves continue to be ceiled; the sanctuaries are generally rectangular, and alone are small and vaulted. Transepts rarely appear; but when they exist, they are very pronounced, projecting beyond the n naves for their entire width. The church of Montmille [2] is o one of the most characteristic among the latter. The nave with its side aisles was ceiled as well as the transepts. Four transverse arches over the crossing probably supported a tower;

the choir alone is vaulted.

Note 1.p.163. See Monum. de l'anc. Beauv., by M. F. Woittez. Paris. 1839.1849.

Note 2.p.163. Priory of Montmille, church of S. Maxien, 11 th century.

From the 11 th century was built at Paris the church of the priory of S. Martin-des-Champs of the order of Cluny, whose choir still exists. Already in that edifice the sanctuary is enclosed by a side aisle with radiating chapels.[1] Same arrangement in the abbey church of Morienval, which dates from the beginning of the 11 th century.

Note 1.p.164. Nearly all the high and low vaults of this c choir were rebuilt about the end of the 12 th century.

But in the 12 th century in Ile-de-France, religious architecture took a great flight. At the middle of that century a abbot Suger built the abbey church of S. Denis with numerous radiating chapels around the choir. Immediately afterwards ar arose the cathedrals of Noyon, Senlis,[2] Paris,[3] the abbey church of S. Germer, the church of S. Maclou, of Pontoise, of which there remains only some old portions of the apse, the churches of Bagneux and of Arcueil, that of the abbey of Montmartre, the little church of S. Julien-le-Pauvre at Paris, th that of Vernouillet, of Vetneuil, whose choir alone of the 1 12 th century exists, the church of Vesles, the choir of the abbey church of S. Germain-des-Pres at Paris, the churches of S. Etienne of Beauvais,[4] of S. Evremont at Creil, of S. Martin of Laon, the abbey church of S. Leu of Esserent, and the cathedral of Soissons.[5]

Note 2.p.164. In the 12 th century the cathedral of Senlis had no transept.

Note 3.p.164. All causes the supposition that the plan of the cathedral of Paris was originally conceived without a transept, like the church of Notre Dame of Mantes and the collegiate church of Poissy, also later the cathedral of Bourges.

Note 4.p.1.4. The single nave dates from the 12 th century; the choir has been rebuilt.

Note 5.p.164. This concerns only the southern transept of t that cathedral.

FRENCH CHAMPAGNE SCHOOL. This school is a derivative from the preceding; but it borrows certain characteristics from the

school of Champagne, which is more robust and retains the traditions of antique architecture. The materials of Brie have little resistance, and the constructors have taken into account their defect in solidity by giving piers and walls greater thickness, and making their edifices lower than in Ile-de-France proper.

The cathedral of Meaux still entirely belongs to the French school;[6] but the influence of the school of Champagne makes itself felt at the end of the 12 th century in the churches od S. Quiriace of Provins, Moret,[7] Nemours, Champeaux, Brie-Comte-Robert.

Note 6.p.184. The cathedral of Meaux has been modified since the end of the 12 th century, the epoch of its construction. (Art. Cathedrale).

Note 7.p.18 . The choir alone dates from the 12 th century; it is without side aisles.

CHAMPAGNE SCHOOL. This is one of the most brilliant' it develops rapidly, and it first attempts are important. The c churches of Champagne of the 10 th and 11 th centuries, like those of Ile-de-France, have naves covered by carpentry; then the sanctuaries alone were vaulted. The great abbey church of S. Remy of Rheims, of an unusual extent, was composed of a ceiled nave with double side aisles vaulted in two stories. A vast choir with side aisles and chapels in the 12 th century replaced the apses with half domes.[1] The church of Notre Dame of Chalons-sur-Marne has only carpentry over the central aisle. When in the 12 th century the choir of that church was rebuilt, vaults were erected over the nave. The important churches of lower Champagne, like those of Ile-de-France, possessed vaulted galleries over the side aisles, comprising the width of these side aisles. In the 1M th century were erected in upper Champagne churches, that approach still more the antique Roman architecture, and which are based on the Burgundian school; for example, such is the cathedral of S. Mammes at Langres, the later charming churches of Montierender, the church of Isomes and of S. Jean Baptiste at Chaumont.

Note 1.p.185. The nave of S. Remy of Rheims, which dates f from the 10 th century, was vaulted in the 12 th. These vaults were rebuilt in lath and plaster a few years since.

BURGUNDIAN SCHOOL. This originated with the Cluniacs.

From the 11 th century it rejected carpentry over the naves; it first made persistent efforts to combine the vault with the plan of the antique basilica. We have a complete example of this in the nave of the abbey church of Vezelay. In the 12 th century this school is powerful, built with large and solid materials; it took from the remains of antique edifices certain architectural details, for example, such as fluted p pilasters and cornices with modillions; it covered the ground with a great number of churches, of which we shall cite only the pr ncipal ones; first Cluny, Vezelay, Charite-sur-Loire; then the churches of Paray-le-Monial, Semur-en-Brionnais, Chateauneuf, saulieu, Beaune, S. Philibert of Dijon, Montreale, at the end of the 12 th century.

The Burgundian school abandoned Romanesque traditions with difficulty, and while were already built in Ile-de-France and lower Champagne churches presenting all the characteristics of Gothic architecture, they followed in Burgundy successfully the Cluniac methods and perfected them.

AUVERGNE SCHOOL. This can pass for the most beautiful R Romanesque school; at alone from the 11 th century knew how t to erect churches entirely vaulted and perfectly stable; hence the type being found, it did not vary from it. At the end of the 11 th and during the 12 th century, there were built in t that province the church od S. Paul of Issoire, the cathedral of Puy-en-Velay, the churches of Notre Dame-du-Port (Clermont), S. Julien of Brioude, and a quantity of small monuments nearly all conceived on the same principle. This school extended at the north even to the banks of the Allier, to Ebreuil, Chatel-Montagne, Cogniat, and to Nevers in the construction of the church of S. Etienne; to the south even to Toulouse (church of S. Sernin), and as far as S. Pepoul.

POITOU SCHOOL. Very fruitful in monuments, because of the quantity and quality of the limestone, this school is less advanced than the school of Auvergne; it possesses in a lower degree the feeling for beautiful arrangement. Like the last, it knew how to build durable vaulted churches after the 11 th century, by abutting the tunnel vaults of the great naves by those of the side aisles, but without the galleries of the second story of the churches of Auvergne, i.e., that the Rom-

Romanesque churches of Poitou are generally composed of three aisles of nearly equal height to the crown, vaulted by means of three tunnel vaults, the central one being wider than the others; while the churches of Auvergne have the side aisles c covered by cross vaults.[1] In Poitou and very early in Auvergne the sanctuaries are surrounded by a side aisle with radiating chapels, as in the church of S. Savin near Poitiers, which d dates from the 11 th century, in the upper church of Champigny. (Beginning of the 12 th century). The school of Poitou is subject to various influences. Besides the principle described above, it accepts the system of domes from the school of Saintonge and Perigord, as in the construction of the church of S. Hilaire of Poitiers, and in that of S. Radegonde with a single aisle. In the 12 th century the school of the West (Pergord and Saintonge) had such a powerful influence, that it not only stifled the school of Poitou, but it soon penetrated into Limousin and Quercy at the south, and in the north even into A Anjou and Maine.

Note 1.p.188. Architecture Religieuse, Fig. 10.

SCHOOL OF PERIGORD. Its primitive type is found at Perigueux in the old cathedral of that city, and in the abbey church of S. Front; it is a Byzantine importation.[2] The principle of this school is that of the dome supported on pendentives. In a time when most Romanesque schools in France did not well know how to solve the problem of placing the vaults on the plans of the antique basilica, that foreign importation must have had a great success. Then men abandoned in the provinces of the West during the 11 th and 12 th centuries, with rare exceptions, the Roman plan to adopt the Byzantine plan. The provinces more particularly attached to the Latin traditions, like Ile-de-France, Champagne and Burgundy, alone resisted that new influence and poursued the solution of the problem proposed, which led them to the Gothic system of construction. Besides the two types that we have just cited, the school of Perigord presents a prodigious number of examples of c churches derived from these types. We shall limit ourselves to citing some of them; the cathedral of Cahors, the abbey church of Souillac (11 th century), that of Solignac, the cathedral of Angouleme, the church of S. Avit-Seigneur, of Vieux-Mariel, S. Jean of Cole, of Tremolac, the abbey church of Fon-

Fontevrault (12 th century), and the greater part of the little churches of Charente.

Note 2.p.188. See Architecture Byzantine en France, by M. Felix Verneilh.

NORMAN SCHOOL. Norman churches before the 12 th century were covered by visible carpentry, excepting the sanctuaries, which were vaulted by half domes. On this principle were erected the two abbey churches of S. Etienne and of S. Trinite at Caen,[1] founded by William the Bastard and Matilda his wife. These primitive arrangements are found again in a very great number of churches in England, while in France they were modified after the 12 th century; vaults replace old carpentry. The Normans were soon skilful and active constructors; so their churches of the 11 th and 12 th centuries are large, if one compares them to the churches of Ile-de-France; the naves are longer as well as the transepts; the choirs were not enclosed by side aisles until about the middle of the 12 th century.

Note 1.p.187. In the 12 th century the naves of these churches were vaulted, the choir of the church of S. Etienne was rebuilt in the 13 th century.

These schools, diverse by their origins and works, each advance on their own part until the moment when is felt the influence of the new architecture of Ile-de-France and of Champagne, the Gothic architecture.

Gothic architecture is one of the most vivid of the expressions of the feeling of the peoples toward unity. Indeed, shortly after its birth, we see the Romanesque schools (of which we have only indicated the principal divisions) disappear, and they accept the new methods adopted by the architects of the royal domain. Yet at the beginning of the 13 th century may still be distinguished three very distinct schools; the school of Ile-de-France, which comprises the basin of the Seine between Montereau and Rouen, those of the Oise and Aisne between Laon, Noyon and Paris, the basin of the Marne between Meaux and Paris, and a part of the basin of the Somme, the Champagne school with its seat at Rheims, and the Burgundian school with its seat at Dijon.

The Norman Gothic school only developed later, about 1260, and its true seat is in England.

The passion for building churches from 1200 to 1250 was such

north of the Loire, that not only many Romanesque monuments were destroyed to give place to new structures, but also without any reason but the love of novelty, were modified and most of the edifices were rebuilt during the 12 th century; the ca cathedrals of Paris, Senlis, Soissons, Laon, Rouen, Mans, Chartres, Bayeux, which present us with striking examples of this need of changing what had just been scarcely completed. The monasteries with more reserve followed this movement toward a renewal of architecture; as for the parishes, those that w were rich did not hesitate to pull down their old churches to construct new ones. So much so that one cannot explain how t there were found during the space of scarcely fifty years enough of building workmen, sculptors, statuaries, glass painters, to execute such a prodigious number of edifices on a territory, which scarcely comprised a third of present France. Soon even the provinces of the Centre, the East and the West followed the impulse, and these workmen spread outside the p provinces in which Gothic architecture had its birth. Although more than half the old churcher have been demolished since the end of the last (18 th) century, there still remains in France a considerable quantity of these edifices. We shall restrict ourselves to giving here a list of those, which present enough interest from the point of view of art to be placed in the r rank of historical monuments, like cathedrals, monastery or parish churches.

To facilitate researches, we shall classify these churches by Departments and Arrondisements (districts), following the alphabetical order.

AIN, department.

Arr. of Bourg;[1] church S. Andre of Bage.

Note 1.p.188. Architecture of the beginning of the 16 th c century; this church was built by the sister of Charles V; it contains beautiful stained glass and magnificent tombs. It s serves today as the chapel of the seminary.

Arr. if Nantua. Church of Nantua.[2]

Note 2. Curious church of the 12 th century, vaulted in 13 th century; style of Haute-Saone.

Arr. of Trevaux. Church S. Paul of Varax.

AISNE, department.

Arr. of Laon. Church Notre Dame of Laon (old cathedral);[3]

Church S. Martin of Laon;[4] church S. Julien of Royaucourt; ch church of Nouvion-le-Vimeux; church of Marle.

Note 3.p.168. One of the most beautiful specimens of the architecture of the beginning of the 13 th century (Arts. Cathedrale, Fig. 8; Clocher, Fig. 73). At the origin the cathedral of Laon possessed a circular apse with side aisle. About 1230 that apse was demolished to be replaced by a square apse. It is difficult to account for the motives of this change. The foundations of the circular choir have been recovered by the architect, M. Boeswilwald, and the capitals forming a part of that primitive sanctuary have been replaced in the square apse. The sculpture of the cathedral of Laon is very beautiful. Villard of Honnecourt cites the towers of Laon and gives a sketch of them.

Note 4.p.168. Church of the 12 th century in a beautiful s style, with chapels in the transepts. The facade is one of t the best examples of the architecture of the 14 th century.

Arr. Chateau-Thierry. Church of Mezy-Moulins; church of Essomes; church of La Ferte-Milan.

Arr. S. Quentin. Collegiate church of S. Quentin.[5]

Note 5.p.168. church with double transepts, of the end of t the 13 th century.

Arr. Soissons. Cathedral church of Soissons;[6] abbey church of S. Medard at Soissons; abbey church of S. Jean-des-Vignes at Soissons;[1] abbey church of S. Julien, do; abbey church S. Yved of Braine.[2]

Note 6.p.168. One transept is semicircular, like those of the cathedrals of Tournay and Noyon.(Art. Architecture Religieuse, Figs. 30, 31). The choir dates from the first years of the 13 th century.(Art. Arc-Boutant, Fig. 52).

Note 1.p.169. This church in great part now destroyed, the facade with its two towers alone exist.

Note 2.p.169. Church S. Yved of Braine is one of the most beautiful monuments of this part of France. The plan of the apse presents an excellent and rare arrangement.(See Monog. de l'Eg.abb.de Braisne, by M. Prioux. This church appears to have been constructed by the architect of the cathedral of L Laon; it dates from the beginning of the 13 th century. The facade and some bays of the nave were destroyed a few years since. The sculptures of the portal are in part deposited in

the museum of Soissons. Church S. Yved constructed before the revolution; magnificent tombs of enameled copper, drawings of which are now found in the collection Goignères of the Bodleian library of Oxford.

Arr. Vervins. Church of Aubenton; church S. Michael (near Hirson); church of Esqueheries; church of Vacqueresse.

ALLIER, department.

Arr. Moulins. Cathedral of Moulins; church of Bourbon-l'Archimbault; church of S. Menoux;[3] abbey church of Souvigny;[4] church of Meilliers; church of Toulon.

Note 3.p.169. Church with nave formerly covered by carpentry, restored in 9 th or 10 th century. The choir dates from the 12 th century; it belongs to a mixed style, between that of Auvergne and that of Burgundy.

Note 4.p.169. Great church of the 11 th and 12 th centuries, but almost entirely rebuilt in the 15 th.

Arr. of Gannat. Church of Gannat;[5] church of Ebreuil;[6] church of Biozat; church of S. Pourcain;[7] church of Cogniat;[8] church of Vicq; abbey church of Chantel.[9]

Note 5.p.169. choir of the church of Gannat is of the pure style of Auvergne of the end of the 11 th century. The nave was rebuilt in the 14 th; it is of a good style.

Note 6.p.169. The nave and choir of the church of Ebreuil are of the 11 th century; the tower is of the 12 th and rests on the narthex.

Note 7.p.169. Nave of the 11 th century, Auvergne style; c choir of the 13 th century.

Note 8.p.169. Very pretty little church of the 12 th century in Auvergne style; nave without side aisles, with two little apses opening into the transepts' tower over middle of t transverse aisle.

Note 9.p.169. Pretty church in Auvergne style of the 12 th century.

Arr. of La Palisse. Church of Chatel-Montagne.[10]

Note 10.p.169. Auvergne style, 11 th and 12 th centuries. M magnificent narthex added in 12 th century, with gallery over, lighted from the facade; tower over transverse aisle.

Arr. of Montlucon. Church of Huriel; church of Veris.

ALPES BASSES, department.

Arr. of Digne. Church of Notre Dame at Digne(cathedral); ch

church of Seyne.

Arr. of Barcilonette. Church of Allos.

Arr. of Castellane. Old cathedral of Senez.

Arr. of Forcalquier. Church of Manosque.

Arr. of Sisteron. Church of Sisteron.

ALPES HAUTES, department.

Arr. of Gap. Church of Lagrand.

Arr. of Embrun. Old cathedral of Embrun.

ARDECHE department.

Arr. of Privas. Church of Bourg S. Andeol; church of Cruas; cathedral church of Viviers.[1]

Note 1.p.170. Choir of 14 th century, without side aisles.

Arr. of Argentiere. Church of Thines.

Arr. of Champagne. Church of Champagne.

ARDENNES department.

Arr. of Braux. Church of Braux.

Arr. of Retnel. Church S. Nicolas of Rethel.

Arr. if Sedan. Church of Monzon.[2]

Note 2.p.170. Beautiful plan of the 13 th century.

Arr. of Vouziers. Church of Vouziers; church of Bouilly; church of Verpel; abbey church of Althigny, church of S. Vaux-bourg.

ARIEGE, department.

Arr. of Foix. Church of Unac.

Arr. of S. Gisors. Church of S. Lizier.[3]

Note 3.p.170. Church without side aisles, with a choir and two chapels in the transepts; beautiful plan of the 12 th century; cloister.

Arr. of Pamiers. Church of Roque; church of Mirepoix.

AUBE, department.

Arr. of Troyes. Church of S. Peter (cathedral);[4] church of S. Urbain of Troyes;[5] church of the Madelaine, do.;[6] church of S. Andre, do.; church of S. Jean, do.; church of S. Nizier, do; church of S. Pantaleon, do.; church of S. Gilles;[7] church of Berulle; church of Montieramy.

Note 4.p.170. Choir of the 13 th century, nave of 14 th and 15 th, facade of 1. th; choir one of the largest in France; i its architecture strongely recalls that of the choir of the abbey church of S. Denis; it still retainr all its stained g glass, which is magnificent.

Note 5. p.170. Church S. Urbain of Troyes, built during the last years of the 13 th century, is the most remarkable example of the Gothic style of Champagne at its final development. (Art. construction, Figs 102 to 106). The nave has remained unfinished. This church is small, its choir without side aisle, but should possess three towers, one on the transverse aisle and the two others on the facade.

Note 6.p.170. Remains of a charming church of the end of the 12 th century; rood screen of the 16 th.

Note 7.p.170. Little half timber church of the end of the 1 14 th century.

Arr. of Arcis-sur-Aube. Church of Arcis-sur-Aube; church of Uitre.

Arr. of Bar-sur-Aube. Church of S. Maclou at Bar-sur-Aube; Church of S. Pierre, do.; church of Rosnay.

Arr. of Bar-sur-Seine. Church of Foucheres;[8] church of Mussy-sur-Seine; church of Ricey-Bas; church of Rumilly-les-Vaudes; church of Chaource.

Note 8.p.170. Nave Romanesque, choir of the 13 th century.

AUDE, department.

Arr. of Carcassonne. Old cathedral of S. Nazaire of Carcassonne;[9] church of S. Michel of lower city at do.; (present cathedral); church of Rieux-Minervois;[1] church of S. Vincent of Montreal.

Note 9.p.170. One of the most remarkable edifices of the s south of France; nave dates from the 11 th century, choir and transepts from the beginning of the 14 th (Arts cathedrale, Fig. 48; construction, Figs. 109 to 114); magnificent stained glass from the 14 th century, remains of paintings of the same epoch.

Note 1.p.171. Circular church of the end of the 11 th century.

Arr. of Castelnaudry. Old cathedral of S. Papoul.[2]

Note 2.p.171. Vestiges of the Auvergne style of the 11 th c century in the apse.

Arr. of Limoux. Old cathedral of Alet; abbey church of S. H Hilaire at Limoux.

Arr. of Narbonne. Old cathedral of Narbonne;[3] church of S. Paul, do.;[4] abbey church of Fontfroide.[5]

Note 3.p.171. Erected at the beginning of the 14 th century, choir alone completed. (Art. cathedrale, Fig. 48).

Note 4.p.171. Choir of the 12 th century with side aisles and radiating chapels; triforium over the chapels in the height of the side aisle. Edifice much mutilated today, but presenting an unique arrangement.

Note 5.p.171. Cistercian church of the end of the 12 th century; nave with pointed tunnel vault, side aisles with half tunnel vaults.

AVEYRON, department.

Arr. of Rodez. catnedral of Rodez; abbey church of S. Foi a at Gonques;[6]

Note 6.p.171. Great church of the 12 th century with side aisles and transepts; side aisles around choir; three apsidal chapels and four eastern apses on transepts. Stylle much recalling that if church S. Sernin of Toulouse, nave with round tunnel vault, with galleries in the second story, whose half tunnel vaults abut the thrust of the central tunnel vault, dome of tower over middle of the crossing; narthex.

Arr. of Espalion. Church of Perse.

Arr. of S. Afrique. Abbey church of Belmont.

Arr. of Villefranche. Abben church of Villefranche.

BOUCHES-DU-RHONE, department.

Arr. of Marseilles. Abbe: church of S. Victor at Marseilles;[7]

Note 7.1.171. Fortified abbey church, 11 th, 12 th and 13 th centuries.

Arr. of Aix. Cathedral church of Aix, church S. Jean at Aix; abbey church of Silvacane;[8] church S. Laurent at Salon.

Note 8.p.171. Cistercian church of 12 th century, of great simplicity; rectangular apse; four square eastern chapels opening into transepts, nave with slightly pointed tunnel vault, with abutting vaults of side aisles, three fourths of round tunnel vault.

Arr. of Arles. Abbey church of S. Trophime at Arles;[9] church S. Cesaire, do.; church S. Jean, do.(museum); church S. Honorat, do.; church S. Gabriel; abbey church of Montmajour; church S. Maries;[10] church S. Martne at Tarascon.

Note 9.p.171. Beautiful cloister' portal of 12 th century, very rich in sculptures.

Note 10.p.171. Church with single nave, with semicircular apse vaulted with dome. Nave with slightly pointed tunnel vault with transverse arches. This church is fortified and dates

from the 12 th century.(See Arch. de la Com. des mon. Hist, pub. under auspices of minister of state).

CALVADOS, department.

Arr. of caen. Abbey church of Trinite at Caen;[1] abbey church of S. Etienne, do.;[2] church of S. Gilles, do.;[3] church of Notre Dame, do.; church of S. Pierre, do.;[4] church of S. Jean, do.; church of S.Nicolas, do;[5] church of Bernieres; church of S. Contest; church of Fresne-Camilly; church of priory of S.Gabriel; church of Norey; church of Ouistreham; church of Secqueville-en-Bessin; church of Thaon; church of Bretteville-l'Orgueilleuse; church of Langrune; church of mathieu; church of Cully; church of Audrien; church of Mouen, church of Douvres; church of Fontaine-Henry.

Note 1.p.172. Founded by Matilda, wife of William the Conqueror, but almost entirely rebuilt in the 12 th century. Apse without side aisle; narthex; tower over middle of crossing and two towers on the facade.

Note 2.p.172. Founded by William the Conqueror. Upper parts of nave rebuilt in the 12 th century, choir rebuilt in the 13 th, with side aisle and radiating chapels, two towers on the facade, a tower over the middle of the crossing.

Note 3.p.172. Nave of a charming church of the end of the 1 12 th century, whose vaults were rebuilt in the 15 th; archivolts of side aisles round.

Note 4.p.172. Church almost entirely of 16 th century, in a very florid style.

Note 5.p.172. Beautiful plan of the end of 12 th century.

Arr. of Bayeux. Cathedral church of Bayeux;[6] church of Tour near Bayeux;[7] church of S. Loup, do.;[8] church of Asnieres; c church of Golleville; church of Etreham; church of Formigny; church of Louvieres; church of Ryes; church of Vierville; church of Campigny; church of Gueron; church of Marigny; church of Bricqueville, church of S. Marie-aux-Anglais;[9] church of V Vouilly.

Note 6. p.172. Nave whose lower parts date from the 12 th century and upper parts from the 13 th. Choir of the middle of 13 th century, style Norman Gothic; two towers on facade, a t tower over the crossing.

Note 7. p.172. Small church whose apse of the 14 th century presents a particular arrangement (Art. Abside, Fig. 12), imi-

imitated from the apse of the chapel of the seminary of Bayeux, which dates from the 13 th century.

Note 8.p.172. charming tower of the 12 th century.

Note 9.p.172. Small church of the 12 th century, composed of a single nave with square apse; that apse alone is vaulted, it still retains traces of the paintings of the 13 th century.

Arr. of Falaise. Church S. Gervais at Falaise; church S. J Jacques, do.; church of Guibray near Falaise; church of Maizieres; church of Sassy.

Arr. of Lizieux. Church S. Pierre at Lizieux; church S. Pierre-sur-Dive, church of Vieux-pont-En-Auge; church of Breuil.

Arr. of Pont-l-Eveque. Church S. Pierre at Tonques.

Arr. of Vire. Church of Vire.

CANTAL, department.

Arr. of Aurillac. Church of Montsalvi.

Arr. of S. Flour. Abbey church of Ville-Dieu.

Arr. of Mauriac. Church Notre Dame des Miracles at Mauriac; church of Ydes; church of Brageac; church of S. Martin-Valmeroux.

Arr. of Murat. Church of Bredons.

CHARENTE, department.

Arr. of Angouleme. Cathedral church of Angouleme;[10] abbey church of S. Amant of Boise;[1] abbey church of Couronne; church of S. Michel of Entraigues;[2] church of Chaumont; church of Roullet;[3] church of Plassac; church of Torsac; church of Montberan;[4] church of Moutniers.

Note 10.p.172. Church with domes, 11 th and 12 th centuries. (Art. Cathedrale, Figs. 41, 42).

Note 1.p.173. Church of the 12 th century with domes, with gallery beneath calotte of central dome. Beautiful plan. Apse with chapels in the axes of the side aisles of nave; and two larger chapels at east of transepts. One of the most remarkable edifices of Charente.

Note 2.p.173. Circular church of 12 th century.

Note 3.p.173. Church with a single nave, domes.

Note 4.p.173. Church with very particular apsidal arrangement; chapel on the axis of the sanctuary; 4 niches at right a and left of that chapel, that appear to have been intended to deposit reliquaries; two eastern chapels attached to transepts, 12 th century.

Arr. of Barbezieux. Church of Aubeterre; church of Montmoreau;

church of Riou-Martin.

Arr. of Cognac. Church of Chateauneuf; church of Gousac;[5] church of Richemont.

Note 5.p.173. Church with a single narrow nave, covered by a domes, 12 th century; choir of the 13 th century.

Arr. of Consolens. Church of S. Barteelemy at Consolens; church of Lesterps.

CHARENTE-INFERIEURE, department.

Arr. of Rochelle. Church of Esnandes.

Arr. of Marennes. Church of Marennes; church of Echillias; church of Moëse; church of S. Denis of Oleron.

Arr. of Rochefort. Church of Surgeres.[6]

Note 6.p.173. Beautiful facade of 12 th century, whose lower portion alone remains. Style of Saintonge.

Arr. of Saintes. Church of S. Eutrope at Saintes;[7] church of S. Pierre, do.; church S. Marie-des-Dames, do.;[8] church of S. Gemmes; church of Retaud; church of Thezac.

Note 7.p.173. Vast crypt of 11 th and 12 th centuries.(Art. Crypte, Figs. 10, 11). One of the purest examples of the architecture of the 12 th century in Saintonge. (Art. Chapelle, Fig. 33). Tower of the 15 th century.

Note 8.p.173. Very remarkable tower over the crossing.(Art. Clocher, Fig. 14). monument of 11 th and 12 th centuries of which remain beautiful parts, notably on the facade; sculpture of Saintonge in a beautiful style.

Arr. of S. Jean d'Angely. Church of S. Pierre at Aulnay; c church of Fenioux.

CHER, department.

Arr. of Bourges. Cathedral church of Bourges;[9] church S. Bonnet at Bourges; church of Aix-d'Angillon; church of Mehun-sur-Yevre; church of Plainpied.

Note 9.p.173. Church of 13 th century with crypt and without transepts; double stairs; beautiful collection of stained glass of 13 th and 14 th centuries.(Art. Cathedrale, Fig. 8).

Arr. of S. Amand. Church of Celle-Bruere; church of Charly; church of Conde; abbey church of Noirlac; church of Dun-le-Roy; church of S. Pierre des Etieux; church of Theuil; church of C Chateaumeillant.

Arr. of Sancerre. Church of Aubigny; church of Jars; church of S. Satur.

CORREZE, department.

Arr. of Tulle. Catnedral church of Tulle;[1] church of Uzerche.[2]

Note 1.p.174. Nave of 12 th century; tower on porch, of 13 th and 14 th centuries, apse exists no longer. Edifice in a bastard style that belongs to the Auvergne style and that of Lyonnais.

Note 2.p.174. Pretty monument of 12 th century and very simple. Mixed style.

Arr. of Brives. Church of S. Martin at Brives-la-Gaillarde;[3] church of Arnac-Pompadour; church of Aubazine;[4] church of Beaulieu;[5] church of S. Cyr-la-Roche; church of S. Robert.

Note 3.p.174. Very curious church; apse in Auvergne style; nave of 13 th century, with side aisles whose vaults are as high as those of the nave; cylindrical piers.

Note 4.p.174. Transept with 6 square eastern chapels; dome, and tower over middle of crossing; pointed tunnel vault, 12 th century. Beautiful tomb of S. Etienne, bishop, 13 th cent.

Note 5.p.174. Beautiful church of the 12 th century.

Arr. of Ussel. Church of Ussel; church of S. Angel;[6] church of Meymac.

Note 6.p.174. Small church with apse with low niches, as if to place tombs or reliquaries, 12 th century. Simple style.

COTE D'OR, department.

Arr. of Dijon. Abbey church of S. Benigne of Dijon (cathedral);[7] church Notre Dame of Dijon;[8] church S. Michel, do.;[9] church S. Etienne, do.; church S. Philibert,do.; church S. Jean, do.; church of the Chartreuse, do.; church of S. Seine,; church of Rouvres; church of Plombierer; church of Thil-Chatel.

Note 7.p.174. Remains of a crypt of 11 th century.(Art. Crypte, Fig. 5). Church rebuilt at end of 13 th century in place of the church of 11 th century. Apse without side aisle; two chapels in the transepts, nave of great simplicity; capitals without sculpture, two towers on facade in poor style; wooden spire of 17 th century on the middle of crossing.

Note 8.p.174. Most complete type of the Burgundian architecture of the 13 th century (about 1230). Vast porch, apse without side aisle; tower on middle od crossing,whose arrangement is one of the most remarkable, although one cannot judge of it today because of additions. (Art. Construction, Figs. 75 to 82).

Note 9.p.174. Facade of 16 th century, style of Burgundian Renaissance.

Arr. of Beaune. Church of Beaune;[10] churhc of Meursalt; church of S. Sabine.[11]

Note 10.p.174. Church of 12 th century, style of Burgundy; one of the derivotives from the cotherol of Autun. Pilosters fluted; pointed tunnel voult with tronsverse orches, choir with side oisles ond three circulor chopels; porch of 13 th century, not finished; tower over middle of crossing.

Note 11.p.174. Tower on focode with porch below. Of 12 th century, rebuilt in the 13 th, now in ruins.

Arr. of Chatillon-sur-Seine. Churcr of S. Vorle at Chatillon-sur-Seine; church of Aignay-le-Duc.

Arr. of Semur. Church of Notre Dame of Semur;[12] church of Flavigny;[13] abbey church of Fontenoy near Montbard;[1] church of S. Andocne of Saulieu;[2] church of S. Thibault.[3]

Note 12.p.174. Pure Burgundion style of 13 th century; side oisles ond three chopels oround choir; vost porch; mony points of resemblonce to the church of Notre Dome of Dijon; very elegont triforium in the choir. Beoutiful sculpture.

Note 13.p.174. Smoll church of 13 th century with o rood s screen ond chopels of the 16 th century.

Note 1.p.175. Pure Cistercion church.

Note 2.p.175. Burgundion style contemporoneous with cothedrol of Autun ond church of Beoune. Nove olone exists, 12 th century. Two towers on focode; orgon gollery of wood, 15 th century. Frogments of stolls of 13 th century.

Note 3.p.175. Choir portly destroyed, built on the model of thot of church S. Urboin of Troyes. Portol of 13 th century with remorkoblo stotuory.

COTES-DU-NORD, department.

Arr. of S. Brieuc. Cathedral church of S. Brieuc; church of Lanleff; church of Notre Dame of Lamballe; church of Moncontour

Arr. of Dinan. Church S. Sauveur of Dinan; church of priory of Lehon.

Arr. of Lannion. Church S. Pierre of Lannion; church of Treguier. (Old cathedral).

CREUSE, department.

Arr. of Gueret; church of Souterraine.[4]

Note 4.p.175. Beoutiful church of the end of 12 th century with squore opse ond 4 choples in the tronsepts; side oisles of nove very norrow; dome on the first boy with tower obove;

dome at middle of crossing; crypt (see Arch. de la Com. des m mon hist, pub. under ausp. of minister of state); church arranged to be fortified; very high side aisles with vaults abutting those of the nave. One of the most remarkable examples of this mixed style, that commences near Chateauroux, follows t the road of Limoges and extends into Correze.

Arr. of Aubusson; Church of Evaux; church of Fellein.

Arr. of Bourganeuf. Church of Benevent.

Arr. of Boussac. Church of S. Valerie at Chambon.

DORDOGNE, department.

Arr. of Perigueux. Abbey church of S. Front at Perigueux; cathedral;[5] church of la Cite,do.(old cathedral); abbey church of Brantome.[6]

Note 5.p.175. Church whose arrangement is entirely Byzantine and details are Latin, 10 th century. The type of all churches with domes in western France.(Arts. Architecture Religieusel Figs. 4, 5; Clocher, Fig. 1).

Note 6.p.175. Church in a good style without side aisles; rectangular apse; side tower; 11 th, 12 th and 13 th centuries.

Arr. of Bergerac. Church of Beaumont; church of Montpazier; abbey church of S. Avit-Seigneur.[7]

Note 7.p.175. One of the derivatives of the church of S. F Front, 12 th century.

Arr. of Nantron. Church of Cercles; church of S. Jean-de-Col; church of Bussieres-Badil.

Arr. of Sarlat. Church of Sarlat (old cathedral)' church of S. Cyprien.

Arr. of Riberac. Church of S. Privat.

DOUBS, department.

Arr. of Besancon. Cathedral church of Besancon;[8] church S. Vincent of Besancon.

Note 8.p.175. Church with Rhenish plan of 12 th century with two apses without side aisles, one at the east and the other at the west. Edifice much mutilated. A crypt formerly under the eastern apse.

Arr. of Montbeliard. Church of Courtefontaine.

Arr. of Pontarlier. Abbey church of Montbenoit; church of priory of Morteau; abbey church of Sept-Fontaines.

DROME, department.

Arr. of Valence. Cathedral church of Valence;[1] church of S.

Bernard at Romans.

Note 1.p.178. Church of 12 th century, style of Lyonnois. T Tunnel vault with transverse arches.

Arr. of Die. Church of Die (old cathedral); church of Chabrillan.

Arr. of Montelimart. Church of Grignan; church of S. Paul-Trois-Chateaux (old cathedral); church of S. Restitut; church of S. Marcel-des-Sauzet; church of Garde-Adhemar.

EURE, department.

Arr. of Evreux. cathedral church of Evreux;[2] church of S. Thorin at Evreux; church of Conches;[3] church of Pacy-sur-seine; church of Vernon; church of Veronet; church of S. Luc.

Note 2.p.178. Church of 11 th, 12 th, 13 th, 14 th, 15 th, and 16 th centuries. Spire of carpentry and lead over crossing.

Note 3.p.178. Magnificent stained glass of 16 th century.

Arr. of Andelys. Church of Grand Andely; church of Petit Andely; church of Gisors.

Arr. of Bernay. Abbey church of Bernay; church of Broglie; church of Fontaine-la-Soret; church of Harcourt; church of Serquigny; church of Boisney; church of Notre Dame of Louviers; church of Pont-de-l'Arche.

Arr. of Pont-Audemer. Church of Annebaut; church of Quilleheuf.

EURE-ET-LOIR, department.

Arr. of Chartres; church of Notre Dame of Chartres (cathedral);[4] church of S. Aignan, do.; abbey church S.Pere, do.;[5] church of S. Andre, do.; church of Gallardon.

Note 4.p.178. Crypt of 11 th century, tower and portal of 12 th, nave and choir of 13 th century. Very beautiful stained glass of 12 th and 13 th centuries.(Arts. Cathedrale, Figs. 11, 12; Clocher, Figs. 58, 59).

Note 5.p.178. Church of beginning of 13 th century, remarkable for lightness of its construction. Beautiful stained glass of the end of the 13 th century. This edifice has suffered important modifications.

Arr. of Chateaudun. Church S. Madelaine at Chateaudun; church of Bonneval.

Arr. of Dreux. Church S. Pierre at Dreux; church of Nogent-le-Roi.

FINISTERRE, department.

Arr. of Quimper. cathedral church of Quimper; church of Loc-

Loctudy; church of Pen-Marc'h; church of Plogastel-S.Germain; church of Pontcroy.

Arr. of Brest. Church Notre Dame of Folgoët; church of Goulsen.

Arr. of Chateaulin. Church of Pleyben; church of Loc-Roman.

Arr. of Morlaix. Church of S. Jean-du-Doigt; church of Lambader; church of S. Pol-de-leon (old cathedral); church Notre Dame of Greisquer at S. Pol-de-Leon.

Arr. of Quimperle. Church of S. Croix of Quimperle.

GARD, department.

Arr. of Nimes. Abbey church of S. Gilles;[1] church of S. Martne of Tarascon.

Note 1.p.177. Portal of 12 th century, whose sculpture presents one of the most complete examples of the school of statuaries of that epoch in Provence. Nave very mutilated; crypt of 12 th century; choir (destroyed) of end of 12 th century, whose ruins offer great interest in regard to perfection of execution.

Arr. of Uzes. Church of Villeneuve-les-Avignon.

GARONNE (HAUTE), department.

Arr. of Toulouse. Cathedral church of Toulouse;[2] monastery church of Jacobins at Toulouse;[3] church of Tour,do.; abbey church of S. Sernin, do.;[4] monastery church of Cordeliers,do.

Note 2.p.177. Nave vast, without side aisles, of 12 th century; choir of 15 th century.

Note 3.p.177. Church with two naves, of end of 13 th century. (Arts. Architecture Monastique, Fig. 24 bis; Clocher, Figs. 76, 77, 78).

Note 4.p.177. The largest edifice in the south of France, 12 th century; choir with side aisles and radiating chapels; transepts with circular eastern chapels, nave with double side aisles returned along transepts. Tower of 13 th century on middle of crossing. Facade unfinished. Nave rebuilt in 15 th century, following the primitive scheme. Tunnel vaults abutted by half tunnel vaults of galleries of second story. Construction of stone and brick. Beautiful sculpture; important fragments of an older edifice. Crypt rebuilt in 14 th century and mutilated recently. Developed style of Auvergne.

Arr. of Muret. Church of Venerque.

Arr. of S. Gaudens. Church of S. Gaudens;[5] church of S. Aventin; church of S. Bertrand-de-Comminges (old cathedral); c

church of S. Just of Valcabrere;[6] abbey church of Montsaumes.[7]

Note 5.p.177. Medium church of 12 th century, of a beautiful style.

Note 6.p.177. Small and very old church; some parts appear to date back to 10 th century. Construction almost entirely renewed in 12 th century. Altar with exhibition of a reliquary elevated above the sanctuary.

Note 7.p.177. Ruin. Beautiful structure of 12 th century.

GERS, department.

Arr. of Auch. Cathedral church of Auch.[8]

Note 8.p.177. Church of 15 th and 16 th centuries. Magnificent stalls and stained glass of 16 th century. Fac.de of 17 th century.

Arr. of Condom. Church of Condom (old cathedral).

Arr. of Lectoure. Church of Fleurance.

Arr. of Lombez. Church of Lombez; church of Simorre.[9]

Note 9.p.177. Small church of 14 th century without side a aisles, with transepts and square apse, built of brick and entirely fortified. No facade; pretty stained glass of 15 th c century.

GIRONDE, department.

Arr. of Bordeaux. Church of S. Andre (cathedral of Bordeaux); church of S. Croix at Bordeaux;[10] church of S. Seurin, do.;[11] church S. Michel, do.; church of Avensan; church of Pouillac; church of Leognan; church of Loupiac of Cadillac;[1] church of Moulis; church of la Sauve.

Note 1.p.178. Very pretty little church of 12 th century; v very complete. Facade on an excellent style; tower rebuilt r recently and skilfully.

Note 10.p.177. Remains of a beautiful facade of 12 th century.

Note 11.p.177. Church of 13 th century, much mutilated. Principal porch of 11 th century, under the tower. Lateral porch of 13 th century, filled with good statues. Crypt.

Arr. of Bazas. Church of Bazas (old cathedral); church of Aillas; church of Pondaurat; church of Uzeste.

Arr. of La Reole. Church S. Pierre of Reole; church of Blazimon; church of S. Ferme; church of S. Vacaire;[2] church S. Michel.

Note 2.p.178. Church of 12 th century with apse and circular transepts, without side aisles. Facade of 13 th century. T Internal paintings of end of 13 th century, [illegible]

spoiled by an unlucky restoration.

Arr. of Lesparre. Church of Begadan; church of Caillan; church of Vertneuil; church of S. Viviere.

Arr. of Libourne. Church of S. Denis of Pilles; church of S. Emilion; church of S. Pierre of Petit Palais; church of P Pujols.

HERAULT, department.

Arr. of Montpellier. Church of Castries; church of S. Croix at Celleneuve; abbey church of S. Guilhem-le-Desert;[3] abbey church of Maguelonne; abbey church of Vignogoul at Pignan; ab- abbey church of Vallemagne; church of Villeneuve-les-Maguelonne.

Note 3.p.178. Pretty church of 12 th century, of a free character belonging to that part of the southern provinces.

Arr. of Bezieres. Church of S. Nazaire of Bezieres (old cathedral);[4] church of Agde (old cathedral); church of Espondeilhan.

Note 4.p.178. Church built in 12 th century and then fortified, rebuilt in great part at the end of the 13 th and fortified anew. Apse without side aisle, surmounted by machicolations with decorated battlements.

Arr. of Lodeve. Church S. Fulcran of Lodeve; church S. Paul of Clermont; church of S. Pons.

ILE-ET-VILAINE, department.

Arr. of Montfort-sur-Mer. Church of Montauban.

Arr. of Redon. Church of S. Sauveur-de-Redon.

Arr. of S. Malo. Church of Dol (old cathedral).[5]

Note 5.p.178. Beautiful church of 13 th century, with square apse in which opens a great glass window as at the back of En- English apses of that epoch.

Arr. of Vitre. Church of Vitre.

INDRE, department.

Arr. of Chateauroux. Church of Chatillon-sur-Indre; abbey church of Deols near Chateauroux;[6] church of Leroux; church of Meobecq; church of S. Genou;[7] church of S. Martin of Ardental.

Note 6.p.178. Ruined church of 12 th century, but whose fragments are of great purity of style. The tower alone exists e entire; it terminates in a stone cone.

Note 7.p.178. Very curious church of 12 th century, which retains in the interior the appearance of an antique basilica.

Arr. of Blanc. Abbey church of Fontgombaud;[1] church of Meo-

Mezieres-en-Brenne.

Note 1.p.179. Large and beautiful church of the 12 th century with side aisles around choir; tower over crossing; tunnel and cross vaults; external galleries around the apse. Nave has been destroyed, choir and transepts alone are standing, and a are now occupied by Trappists.

Arr. of la Chatre. Church of la Chatre,[2] church of Gargilesse; church of Neuvy-S. Sepulchre;[3] church of Nohant-Vic.

Note 2.p.179. Porch with tower above.

Note 3.p.179. Circular church of 11 th century, built in i imitation of the Holy Sepulchre. Nave attached, very old, but rebuilt in 12 th century. (See Arch. de la comm. des mon.hist., published under auspices of minister of state.

INDRE-ET-LOIRE, department.

Arr. of Tours. Cathedral church of Tours;[4] abbey church of S. Martin of Tours;[5] abbey church of S. Julien,do.;[6] church of S. Denis at Amboise; church of Vernon.

Note 4.p.179. Choir of 13 th century, in a beautiful style. Stained glass of the same epoch and intact. Facade of 16 th century.

Note 5.p.179. There remains only the principal tower of this celebrated church.

Note 6.p.179. Church of 13 th century with square apse. Tower over porch of the facade of 11 th century. Paintings.

Arr. of Chinon. Abbey church of S. Mesme at Chinon; church of Azay-le-Rideau; church of Condes; church of Langeais, church of Riviere.

Arr. of Loches. Church of S. Ours of Loches;[7] church of Beaulieu, church of Montresor; church of Preuilly.

Note 7.p.179. Church derived from churches with domes, 11 th and 12 th centuries, without side aisles. Here the domes are replaced by hollow pyramids. (Arts. Coupole, Fig. 15; Clocher, Fig. 27). One tower over the apse, the other over the porch.

ISERE, department.

Arr. of Grenoble. Cathedral church of Grenoble.

Arr. of S. Marcellin. Church of S. Antoine near S. Marcellin; church of Marnans.

Arr. of Tour-du-Pin. Church of S. Chef.[8]

Note 8.p.179. Church composed of a wide nave with side aisles,

narrow transepts with circular apse and four little apses taken in the thickness of the transept walls, 12 th century. So carpentry over nave. Apse and transepts are alone vaulted. Paintings of end of 12 th century in one of the two galleries, that terminate the transepts. The four bays of these transepts are vaulted by means of tunnel vaults perpendicular to the walls and resting on transverse arches constructed at the height of the archivolts connecting the piers of the nave. Towers on rectangular plans at ends of transepts above the galleries. South tower alone exists.

Arr. of Vienne. Church S. Andre-le-Bas at Vienne; church S. Maurice, do.; church S. Pierre, do..

JURA, department.

Arr. of Lons-le-Saunier. Church of Baume-les-Messieurs.

Arr. of Dole. Church of Chissey.

Arr. of Poligny. Church of S. Anatole of Salins.

LANDES, department.

Arr. of Dax. Church of Sordes; church of S. Paul-les-Dax.

Arr. od S. Sever. Church of S. Geron at Hagetman, church of S. Quitterie at Mas-d'Aire.[1]

Note 1.p.180. Near the sanctuary is that church is noted a little cell reserved in the solid wall, in which insane persons were shut.

LOIRE-ET-CHER, department.

Arr. of Blois. Church of S. Laumer at Blois;[2] church of S. Aignan; church of Mesland; church of Nanteuil at Montrachard; church of Cours-sur-Loire, church of S. Lubin at Suevnes.

Note 2.p.180. Beautiful church of 12 th century.

Arr. of Romorantin. Church of Romorantin; church of Lassay; church of S. Thaurin at Selles S. Denis; church of S. Genoux, do.; church of Selles-sur-Cher.

Arr. of Vendome. Abbey church of Trinite at Vendome;[3] church of Troo; church of Lavardin; church of S. Gilles of Montoire.

Note 3.p.180. The tower of this abbey church still exists. (art. Clocher, Figs 53 to 56). It is one of the most beautiful structures of the 12 th century, which is only surpassed by the old tower of the cathedral of Chartres.

LOIRE, department.

Arr. of Roanne. Church of Ambierle; abbey church of Charlieu;[4] church of Benisson-Dieu.

Note 4.p.180. Remains of a very beautiful style, 12 th century.

LOIRE (HAUTE), department.

Arr. of Puy. Cathedral church of Puy;[5] church of S. Jean of Puy;[6] Baptistery at Puy; church S. Laurent, do.; church S. Michel-de-Aiguilhe,do.; church of Chamalieres; church of Monestier; church of Polignac;[7] church of S. Paulien; church of Sanques.

Note 5.p.180. Monument whose arrangement is unique. By passing under a very high porch like a great loggia, one penetrates beneath the pavement of the church, and he ends before a high altar by a stairway. This stairs extended far into the street opposite the portal. Such a strange arrangement was made to allow the numerous pilgrims, who visited Notre Dame of Puy, to pass in procession to the venerated image. The cathedral of Puy presents traces of a very old edifice. Constructions and elevation date from the 11 th century, they were crowned by domes in the 12 th. A lantern rises over the middle of the crossing. The apse was square, and the ends of the transepts are terminated at north and south by little low apses. The external surfaces are composed of white stone (sandstone) and black lava, so as to form great mosaics. There were formerly in the interior numerous paintings of the 12 th century in a grand style, that have been partly destroyed. The cathedral of Puy has retained its dependances, a great hall of the 12 th century, a cloister of the 10 th and 11 th, a chapter hall and a master's house with paintings of the 14th.

Note 6.p.180. Edifice,some parts of which date from the 10

Note 7.p.180. Very pretty church of the 11 th century with three little apses.

Arr. of Brioude. Church S. Julien of Brioude;[8] abbey church of Chaise-Dieu; church of Chanteuges.

Note 8.p.180. Beautiful church of 12 th century and beginning of 13 th; the choir is of the last epoch, but the masses of the architecture and the system of construction have remained Romanesque. The new style makes itself felt only in the details of the sculpture and the mouldings. Numerous traces of paintings.

Arr. of Yssingeaux. Church of Bauzac; church of S. Didier-la-Sauve; church of Ristord.

LOIRE-INFERIEURE, department.

Arr. of Nantes. Cathedral church of Nantes; church of S. J Jacques at Nantes.

Arr. of Savenay. Church of S. Gildas-des-Bois; church S. G Gonstan; church of Guerande.

LOIRET, department.

Arr. of Orleans. Cathedral church of Orleans; church of S. Aignan at Orleans; church of Beaugency; church S. Etienne of Beaugency;[1] church Notre Dame of Clery; church of Germigny-les-Pres;[2] church of Meung; church of chapel S.Mesmin.

Note 1.p.181. Very old church, 9 th or 10 th century. Nave narrow, long and without side aisles. Very pronounced transepts with semicircular eastern chapels; choir almost equal to the nave, apse with half dome. Tunnel vaults, cross vault over middle of crossing, with large tower above. Entire absence of ornamentation. Plastering.

Note 2.p.181. Little church of 9 th century with circular apse and two little apses. Central tower borne on four isolated piers, with passage around them, as in certain Greek churches and in Angoumois. Transverse aisle passing beneath thour, terminated by two circular apses; cross and tunnel vaults. Mosaics with gold ground covering the half dome of the principal apse. Tower with little columns and bands decorated by stucco. (This monument has been published by M. Constant-Dufeux in t the Revue d'Architecture of M. Daly,Vol. 8).

Arr. of Gien. Abbey church of S. Benoit-sur-Loire;[3] church of S. Brisson.

Note 3.p.181. Church of 12 th century with crypt and elevated choir. Vast narthex of 11 th century, with second story in intended to support a tower.(Art. Clocher, Figs. 41, 42). The sanctuary is paved with opus alexandrinum, like many Italian churches.

Arr. of Montargis. Church of Ferrieres; church of Lorris.

Arr. of Pithiviers. Church of Puissaux; church of Yevres-le-chatel.

LOT, department.

Arr. of Cahors. Cathedral church of Cahors;[4] church of Montat.

Note 4.p.181. Church derived from abbey church of S. Front at Perigueux. Domes. This edifice has suffered numerous mutilations since the 14 th century.

Arr. of Figeac. Abbey church of S. Sauveur at Figeac; church of Assier.

Arr. of Gourdon. Church of Gourdon; abbey church of Souillac.[5]

Note 5.p.181. Abbey church derived from that of S. Front. D Domes. circular apse; remains of a porch. Very curious reliefs in the interior of the entrance portal.

LOT-ET-GARONNE, department.

Arr. of Agen. Cathedral church of Agen;[6] old church of Jacobins at Agen;[7] church of Layrac; church of Moiran.

Note 6.p.181. church with domes, in great part rebuilt in 13 th century and vaulted at that time. Apse recalling on the exterior the apses of Avignon.

Note 7.p.181. Internal paintings of 13 th century. Church with two naves.

Arr. of Marmande. Church of Marmande; church of mas d'Agenais.

Arr. of Nerac. Church of Mezin.

LOZERE, department.

Arr. of Mende. Cathedral church of Mende; church of Langogne.

MAINE-ET-LOIRE, department.

Arr. of Angers. Cathedral church of Angers;[1] abbey church of S. Serge at Angers; church S. Martin, do.; abbey church of T Trinite, do.; church of Ronceray, do.; church of Lion d'Angers; church of Savennieres; church of Beaulieu.

Note 1.p.182. Vast church with nave, transepts, choir and a apse without chapels or side aisles. Built about the end of 12 th century, but presenting traces of earlier structures. Cross vaults on square plans, recalling the dome by their very swelled form. Stained glass. Style of Plantagenets. (See Arch. Byz. en France, by M. felix de Verneilh). (Art. Cathedrale, Fig. 43).

Note 2.p.182. Church with domes, but with choir surrounded by chapels with side aisles. (Art. Architecture Religieuse, Figs. 6, 7).

Arr. of Bauge. Church of Pontigne.

Arr. of Beaupreau. Church of Chemille.

Arr. of Saumur. Church of Nantilly at Saumur; church S. Pierre, do.; church of Cunault; abbey church of Fontevrault;[2] church of S. Georges-Chatelaison; church of Montreuil-Bellay; church of Puy-Notre-Dame; church of S. Eusebe of Gennes; church of S. Veterin, do.

MANCHE, department.

Arr. of S. Lo. church of S. Croix of S. Lo; church of Notre

Dame, do.; church of Carentan, church of Martigny.

Arr. of Avranches. Abbey church of Mont S.-Michel en Mer.[3]

Note 3.p.182. Church whose nave dates back to 11 th century; choir from 15 th.(Architecture Monastique, Figs 19 to 22).

Arr. of Cherbourg. Church of Querqueville.

Arr. of Coutances. Cathedral church of Coutances;[4] church of S. Pierre at Coutances;[5] church of Lessay; church of Periers.

Note 4.p.182. Pure Norman church of first half of 13 th century; chapels added to the nave in 14 th.(Art. cathedrale, F Fig. 32).

Note 5. pretty towers of 16 th century.

Arr. of Mortain. Abbey church of Mortain.

Arr. of Valognes. Church S. Marie-du-Mont; church S. Mere-Eglise; abbey church S. Sauveur-le-Vicomte; church S. Michel at Lestre.

MARNE, department.

Arr. of Chalons. Cathedral church of Chalons;[6] church Notre Dame of Chalons;[1] church S. Jean, do.;[2] church S. Alpin, do.; church Notre Dame de l'Epine;[3] church of Vertus; church of C Courtisols.[4]

Note 6.p.182. Champagne church presenting very old arrangements. Choir originally without side aisles, flanked by two towers on rectangular plans. One of these towers dates from beginning of 12 th century. Choir, transepts and nave rebuilt in 13 th century. In 14 th century, chapels with side aisles were added around the sanctuary. Nave rebuilt at several points. After a fire, the edifice was restored in 17 th century in a barbarous fashion. Beautiful fragments of stained glass. (Art. Cathedrale, Fig. 33).

Note 1.p.183. Champagne church built in 12 th century, rebuilt soon after at the end of that century. Nave originally arranged to be covered by carpentry. Choir without side aisles at the origin, side aisles added about 1180. Four towers, two of which are still covered by spires of lead; one of these was rebuilt recently. (Art. construction, Figs. 41, 42, 43).

Note 2.p.183. Nave of 11 th century covered by carpentry. Side aisles rebuilt. Choir and transepts rebuilt in 13 th century, restored in 14 th, 15 th and 16 th.

Note 3.p.183.Celebrated church of 15 th century, one of the most complete examples of that epoch, which modified or ended

so many old churches, and that built so few from bottom to top.

Note 4.p.183. Three churches. Naves with carpentry. 13 th century.

Arr. of Epernay. Church of Epernay; church of Montmort; church of Orbay;[5] church of Avenay; church of Dormans; church of Oger.[6]

Note 5.p.183. The choir alone of this church presents interest, and possesses apsidal chapels; it dates from the beginning of 13 th century; central chapel is larger than the others. S Style of Ile-de-France.

Note 6.p.183. Edifice of 13 th century. Square apse.

Arr. of Rheims. Church Notre Dame of Rheims (cathedral);[7] abbey church of S. Remy at Rheims;[8] church of Cauroy.

Note 7.p.183. (Art. Cathedrale, Figs 13 to 17).

Note 8.p.183. Nave of 10 th century, constructed to receive carpentry with double vaulted side aisles originally, by means of tunnel vaults perpendicular to nave; Choir of end of 12 th century. Beautiful fragments of stained glass. Transepts with eastern chapels in two stories. Gallery of second story vaulted entirely around the edifice. Fac.de of 12 th century (restored). Gable of S. transept of 16 th century. Tomb of S. Remy of 1. th century, in a very mediocre style.

Arr. of S. Menehould. Church of Sommepy.

Arr. of Vitry. Church of Maisons-sur-Vitry;[9] church of Mauruot; church of Cheminon; church of S. Amand.[10]

Note 9.p.183. Nave covered by carpentry, beginning of 13 th century. Polygonad apse. Pretty little edifice.

Note 10.p.183. Edifice of 13 th century in a beautiful style. Porch low, covered by shed roof; nave with side aisles; polygonal Champagne apse without side aisles. Transepts.

MARNE (HAUTE), department.

Arr. of Chaumont. Church S. Jean-Baptiste at Chaumont; church of Vignory.[11]

Note 11.p.183. Church of 10 th century. Naves covered by carpentry; apse vaulted with side aisle and circular chapels.(Art. Architecture Religieuse, Figs. 2,3).

Arr. of Langres. Church S. Mammes of Langres (cathedral);[12] church of Issomes; church of Villars S. Marcellin.

Note 12.p.183. Edifice built from 1150 to 1200. (Art. Cathedrale. Figs 28, 29). Facade modern.

Arr. of Vassy. Church of Blecourt; church of Ceffonds; church of Joinville; church of Moutirender;[13] church S. Aubin at Moëslains; abbey church of Trois-Fontaines.

Note 13.p.183. Choir and transept of beginning of 13 th century. Best example of that epoch in upper Champagne.

MAYENNE, department.

Arr. of Laval. Church of Trinite at Laval; church S. Martin do.; church of Asnieres; church of Evron.

Arr. of Chateau-Gontier. Church S. Jean at Chateau-Gontier; abbey church of la Rue.

Arr. of Mayenne. Church of Javron.

MEURTHE, department.

Arr. of Nancy. Church of Laitre-sous-Amance. Church S. Nicolas-du-Port., church of Mouson.[1]

Note 1.p.184. Great church of 15 th century. Beautiful plan.

Arr. od Sarrebourg. Church of Fenestrange.

Arr. of Toul. Church of Toul (old cathedral);[2] church S. G Gengoulf at Toul, church of Blened-aux-Vignons; church of Minorville.

Note 2.p.184. Choir and transepts of 13 th century, without side aisles. Facade of 15 th century, very rich.

MEUSE, department.

Arr. of Par-le-Duc. Church of Rambercourt-aux-Pots.

Arr. of Montmedy. Church of Avioth.

Arr. of Verdun. Cathedral church of Verdun;[3] church of Etain; abbey church of Lachalade.

Note 3.p.184. (Art. Architecture Religieuse, Fig. 39).

MORBIHAN, department.

Arr. of Vannes. Church S. Gildas-de-Rhuys; church of Ile d' Aiz.

Arr. of Lorient. Church of Hennebon.

Arr. of Ploermel. Church of Ploermel.

Arr. of Pontigny. Church of Quelven at Guern.

MOSELLE, department.

Arr. of Metz. Cathedral church of Metz;[4] church of S. Vincent at Metz, church of Chazelle; church of Vorroy-le-Veneur; church of Jussy.

Note 4.p.184. Church whose nave dates from 13 th century and choir from the 15 th; the latter construction rebuilt entirely in accordance with the preceding. Style Gothic already impres-

impressed with German taste. Very beautiful glass of the 16 th century in the transepts, which are not lighted by Rose windows, but by immense windows comprising the entire space left between the premier gallery and the vaults. The towers, instead of being erected on the facade, are placed on the t third bays of the side aisles of the nave.

Arr. of Briey. Church of Olley; church of Languyon.

NIEVRE, department.

Arr. of Nevers. Cathedral church of Nevers;[5] church of S. Etienne at Nevers;[6] church of Saulge; church of S. Parize-le-Chatel.

Note 4.p.184. Church having an apse at the west built in the 11 th century. Vast transepts into which opens that apse; date likewise of that epoch. The nave was rebuilt in the 13 th century. Restorations and additions during the 14 th and 15 th centuries. This church threatens ruin; the nave leans over; its triforium presents an ornamentation with caryatides and figures of angels in the tympanums, which give a very original appearance to this interior. The edifice is much mutilated by the hand of man and by time.

Note 6.p.184. Auvergne church of 11 th century. (Architecture Religieuse, Fig. 8.).

Arr. of Clamecy. Church S. Martin at Clamecy;[1] church of C Corbigny; church of S. Reverien; church S. Leger at Tannay; church of Varzy.

Note 1.p.185. Church of first half of 13 th century, with square apse and side aisle extending behind the sanctuary. Fo Facade and tower of end of 15 th century.

Arr. of Cosne. Abbey church of S. Croix at la Charite;[2] Church of Danzy; church of Premery.

Note 2.p.185. Great church of order of Cluny, of which remains the choir, a tower and ruins. Very large narthex, with side aisles, 12 th century. Style of architecture of Autun, B Beaune, Paray-le-Monial and Cluny.

NORD, department.

Arr. of Lille. Church S. Maurice at Lille.

Arr. of Avesnes. Church of Solve-le-Chateau.

Arr. of Dunkerque. Church S. Eloi of Dunkerque.

OISE, department.

Arr. of Beauvais. Cathedral church of Beauvais;[3] church of

Basse-oeuvre at Beauvais;[4] church of S. Etienne, do.;[5] abbey church of S. Germer;[6] church of Montagny; church of Trye-Chateau.

Note 3.p.185. Choir of 13 th century! transepts and part of nave of 16 th. This is the largest choir of French churches. (Arts. Cathedrale, Fig. 22; Construction, Figs. 101, 101 bis, 101 ter).

Note 4.p.185. Nave of a church of 8 th or 9 th century, covered by carpentry; facade of 11 th century. Construction without any ornamentation, barbarous Romanesque. Traces of paintings of 12 th century.

Note 5.p.185. Nave of 12 th century, choir of 15 th. Beautiful Renaissance glass. Portal of 12 th century on north side; very ornate, with traces of paintings.

Note 6.p.185. Great church of 12 th century, with vaulted gallery of second story. Holy chapel of 13 th century, isolated at the apse, nearly copied in S. Chapelle of the palace at Paris.

Arr. of Clermont. Church of Clermont; church of Agnetz; church of Maignelay; church of priory of Bury; church S. Martin-aux-Bois; church of Magneville.[7]

Note 7.p.185. For these churches, see the work on the Beauvoisois, by Dr. Woillez.

Arr. of Compiegne. Abbey church S. Antoine at Compeigne; a abbey church S. Jean-aux-Bois;[8] church Notre Dame of Noyon;[9] (old cathedral); church of Pierrefonds;[10] church of Tracy-le-Val.[11]

Note 8.p.185. Pretty little church of beginning of 13 th c century. Beautiful fragments of grisaille glass.

Note 9.p.185. 12 th and 13 th centuries.(Art. Cathedrale,Fig.7

Note 10.p.185. Crypt of very early epoch partly excavated in the rock. Tower terminated by a top in the 16 th century.

Note 11.p.185. Charming tower of end of 12 th century. (Art. Clocher, Fig. 49).

Arr. of Senlis. Church of Senlis (old cathedral);[12] collegiate church S. Frambourg at Senlis; church S. Vincent, do.; church of Acy-en-Multien; abbey church of Chaalis; church Notre Dame of Chambly; church of Creil (en l(isle);[1] abbey church S. Leu of Esserent;[2] collegiate church of Mello;[3] collegiate church of Montataire; abbey church of Morienval;[4] church of

Nogent-les-Vierges; church of Ermenonville; church of Baron; church of Verberie.

Note 12.p.185. Edifice of end of 12 th century, with voulted gallery of second story. This church originally had no transepts; its transepts were established in the 15 th century by cutting off two bays of the nave. Very narrow radiating chapels. Beautiful tower of beginning of 12 th century. (Art-Clocher, Fig. 63).

Note 1.p.186. Ruins of a very beautiful church of 12 th cent.

Note 2.p.186. Narthex of 11 th century, with hall in second story. Choir of end of 12 th. Little radiating chapels around the side aisle of the apse. Tower of 13 th century. Extreme of chevet possesses a story at the height of the triforium.

Note 3.p.186. End of 12 th century. Much mutilated.

Note 4.p.186. church of end of 11 th century, with chapels around the side aisle of the sanctuary, that date from that epoch. A tower of the beginning of the 12 th century on the facade and two towers at the two sides of the choir. Considerable rebuildings in the 14 th century.

ORNE, department.

Arr. of Alencon. Church Notre Dame of Alencon; cathedral c church of Seez.[5]

Note 5.p.186. Remains of a portal of end of 12 th century. Nave of 13 th century, Norman style. Choir of end of 13 th century, French style. Two towers of 13 th century on the facade. This edifice threatens ruin at several points' and has suffered serious mutilations. The apsidal chapels date from the middle of the 13 th century.

Arr. of Argentan. Church S. Martin at Argentan; church of Chambois.

Arr. of Domfront. Church Notre Dame sous-l'Eau at Domfront; church of Lonlay-l'Abbaye.

PAS-DE-CALAIS, department.

Arr. of S. Omer. Church Notre Dame at S. Omer (old cathedral); abbey church S. Bertin at S. Omer; church of Acre-sur-la-Lys.

PUY-DE-DOME, department.

Arr. of Clermont. Catnedral church of Clermont;[6] church Notre-Dame-du-Port at Clermont;[7] church of S. Cerneuf at Billom; church of Chauriat; church Notre D.me of Orcival; church of Montferrand; church of Royat;[8] church of S. Saturnin; church

of Chamalieres.

Note 6.p.188. church rebuilt at end of 13 th century on an old edifice of 11 th century. (Art. Cathedrale, Fig. 42).

Note 7.p.188. Edifice of 11 th century, pure Auvergne style. Cryp. (Art. Architecture Religieuse, Figs 9, 10, 10 bis).

Note 8.p.188. Little Auvergne church of 11 th century, fortified and restored at the end of the 12 th. Crypt.

Arr. of Issoire. Church S. Paul at Issoire;[9] church of Chambon; church of Monglieu; church of S. Nectaire.[10]

Note 9.p.188. Pure Auvergne style. great church of 11 th c century. Crypt.

Note 10.p.188. Same as the last.

Arr. of Riom. Church Notre-Dame-du-Marturet at Riom; church of S. Amable of Riom; church of Ennezet;[11] church of S. Hilaire-la-Croix; churhc of Mozat; church of Thuret; church of V Volvic;[12] church of Sondat; church of Menat.

Note 11.p.188. Nave of 11 th century; choir and transepts of 13 th. Paintings.

Note 12.p.188. Very pretty church of 13 th century, Auvergne style.

Arr. of Thiers. church S. Genest of Thiers; church of Dorat.

PYRENEES, BASSES, department.

Arr. of Pau. Church of Lembeye; church of Lescar; church of Morlas.

Arr. of Bayonne. cathedral church of Bayonne.[1]

Note 1.p.187. 13 th, 14 th and 15 th centuries.

Arr. of Mauleon; church S. Engrace.

Arr. of Oloron. Church S. Croix at Oleron; church S. Marie at Oloron.

PYRENEES, HAUTES, department.

Church of Luz;[2] church S. Savin; church of Ibas near Tarbes.

Note 2.p.187. Little fortified church.

PYRENEES, ORIENTALES, department.

Arr. of Perpignan. Church S. Jean at Perpignan (now cathedral); church of Elne.[3]

Note 3.p.187. 12 th century.

Arr. of Ceret. Church of Coustouges.

Arr. of Prades. Church of Marceval; abbey church S. Martin du Canigou;[4] church of Corneilla; church of Serrabone;[5] church of Villefranche.

Note 4.p.187. 12 th century.

Note 5.p.187. 12 th century.

RHIN, BAS, department.

Arr. of Strasburg. Cathedral church of Strasburg.[6] church S. Pierre at Strasburg; abbey church of S. Etienne, do.; church S. Thomas, do.; church of Niederhaslach.

Note 6.p.187. Choir and transepts of 12 th century. Crypt. Nave of 13 th century; Fac.de of 14 th and 15 th centuries. Beautiful glass. Stone spire very remarkable from point of view of construction.(Art. Fleche).

Arr. od Saverne. Church S. Jean-des-Choux; abbey church of Marmoutier;[7] church of Neuweiler.[8]

Note 7.p.187. Rhenish style, 12 th century. Porch between two towers.

Note 8.p.187. Church of end of 12 th century. Isolated chapel at the apse, of 10 th century.(Art. chapelle, Figs.22,23).

Arr. of Schelestadt. Church S. George of Schelestadt; church S. Foi at Schelestadt;[9] church of Andlau; abbey church of S. Odile; church of Rosheim.[10]

Note 9.p.187. Church of 11 th and 12 th centuries, Rhenish style. Tower on centre of crossing. Porch between two towers on the facade.

Note 10.p.187. Pretty church in Rhenish style, 11 th and 12 th centuries. Beautiful sculpture.

Arr. of Wissembourg. Church of Wolbourg.

RHIN, HAUT, department.

Arr. of Colmar. Church S. Martin at Colmar; church of Guebershwyr; church of Guebwiller;[11] church of Pfaffenheim; church of Ruffach; church of Sigolsheim; church of Luttenbach; a abbey church of Murbach.[12]

Note 11.p.187. Pretty church of end of 12 th century and of the 13 th. Porch between two towers on the facade. Tower on middle of crossing; Beautiful Rhenish construction.

Note 12.p.187. Remains of a beautiful church of 12 th century. Two towers at the two sides of the choir. Pure Rhenish style.

Arr. of Altkirch. Church of Ottmarsheim.[13]

Note 13.p.187. Octagonal church; imitation of Aix-la-Chapelle.

Arr of Belfort. Church of Thann.

RHONE, department.

Arr. of Lyons. Catnedral church of Lyons;[1] church S. Vizier, do.; church of Ainay,[2] do.; church S. Paul, do.; church S. Irene, do.; church of Ile-Barbe.

Note 1.p.188. Choir of end of 12 th century, without side o oisles, with two deep chopels opening from transepts. Nave of 13 th and 14 th centuries. Facade of 14 th. Towers at both sides of choir. Singular mixture of Gothic styles of upper Burgundy, Bourbonnois, Up. Marne and Rhine.

Note 2.p.188. Little church of which some parts are very o old and date from the 8 th century. Tower of 11 th, apse of some epoch. Edifice that has suffered much from restorations. The apse without side aisles belongs to the style of Auvergne.

Arr. of Villefranche. Church of Villefranche, church of Salles; church of Belleville; church of Chatillon-d'Azergue.

SAONE, HAUTE, department.

Arr. of Vesoul. Abbey church of Cherlieu; church of Faverney; church of Chambarnay-les-Bellevaux.

Arr. of Lure. Abbey church of Luxeuil.

SAONE-ET-LOIRE, deparmentt.

Abbey church S. Vincent at Macon; abbey church S. Philibert at Tournus;[3] church of Brancion; church of Chapaise; abbey c church of Cluny;[4] church Notre Dame at Cluny.[5]

Note 3.p.188. Nave of beginning of 11 th century, with vast narthex. The high vaults of nave present the peculiarity, that they are composed of round tunnel vaults and are abutted by those of the side aisles, which are cross vaults. The piers are single columns, terminated by flat capitals without ornaments, like simple cords. The narthex is in two stories. Transepts and choir of beginning of 12 th century, with crypt, side aisle and rectangular chapels. Square tower over middle of crossing and two towers on the first bays of narthex, of 12 th century.(Art. Architecture Monastique, Fig. 3, and Arch des mon. hist.).

Note 4.p.188. Art. Architecture Monastique, Fig. 2. Church of which nothing now remains but one transept.

Note 5.p.188. Pretty church of beginning of 13 th century, of the better style of upper Burgundy. Lantern over centre of crossing.

Arr. of Autun. Cathedral church of Autun.[6]

Note 6.p.188. Church of 12 th century, with open porch and

little later than the original construction. Style of upper F Burgundy. Nave with pointed tunnel vault with pointed transverse arches. Choir without side aisles. (Arts Architecture R Religieuse, Fig. 20, _athedrale, Fig. 27). Stone spire of 15 th century over middle of crossing. Flying buttresses of 15 th century abutting the high vaults.

Arr. of Chalon. Church S. Vincent at Chalon; church S. Marcel; church of Sennecy-le-Grand.

Arr. of Charolles. Church of Paray-le-Monial;[7] church of Semur-en-Brionnais;[1] church of Anzy. church of Bois-S-Marie;[2] church of Chateauneuf;[3] church of S. Germain.

Note 7.p.188. Very remarkable edifice contemporaneous with cathedral of Autun (12 th century), with closed porch in two stories; sanctuary with side aisle and three radiating chapels. Central tower octagonal. Two towers on the two first bays of the porch. (See Arch. des mon. hist). Beautiful structure executed in beautiful materials.

Note 1.p.188. Edifice of end of 12 th century. Style of upper Burgundy. Flowery transiticnal Romanesque. Beautiful structure.

Note 2.p.188. Little church of 12 th century, whose choir presents in plan an entirely special arrangement. Side aisle without radiating chapels, the sanctuary supported by clusters of columns, two larger ones set radially, and two smaller ones set t.ngent. Tower central, nave with pointed tunnel vault on transverse arches; cross vaults over side aisles, without flying buttresses.

Note 3.p.188. Little church of 12 th century without transepts; nave with narrow side aisles and three apses. Square tower before sanctuary. High pointed tunnel vaults, abutted by r rampant cross vaults over side aisles. The central tunnel vault returned alone marks the transept in elevation.

SARTHE, department.

Arr. of Mans. Cathedral church of Mans;[4] church of Notre-Dame-du-Pre at Mans;[5] church Notre-Dame-de le Coulture at Mans.[6]

Note 4.p.188. Nave of 11 th century, repaired and vaulted in 12 th; originally covered by carpentry. Choir of 13 th century. Style mixed French-Norman. (Art. Cathedrale, Figs. 34, 35). Stained glass.

Note 5.p.188. Little church of beginning of 11 th century,

repaired in the 12 th; originally covered by visible carpentry.

Note 6.p.189. Nave without side aisles, of 12 th century. I Influence of western style, choir of end of 12 th century. P Porch of 13 th. Crypt.

Arr. of Fleche. Church of priory of Solesmes; church of Bazouges; church of la Bruyere.

Arr. of Mamers. Church of Ferte-Bernard.[7]

Note 7.p.189. Very pretty church of 16 th century, in which Gothic traditions are very skilfully retained in a new form. Stained glass.

Arr. of S. Calais. Church of S. Calais.

SEINE, department.

Arr. of Paris. Church Notre Dame (cathedral of Paris);[8] abbey church S. Germain-des-Pres, do.;[9] church S. Germain-l'Auxerrois, do.;[10] church S. Eustache, do.;[11] church S. Merry, do.; church S. Severin, do.; church of priory of S. Martin-des-Champs, do.;[12] church S. Julien-le-Pauvre, do.[1] church S. Etienne.-du-mont, do.; church Ss. Gervais and Protais, do.

Note 8.p.189. Cathedral of end of 12 th century, nave and n portal of beginning of 13 th. Transept gables of middle of 13 th century. Choir chapels of 14 th. (Art. Cathedrale, Figs. 1 to5

Note 9.p.189. Nave of 11 th century, entirely rebuilt. Choir of end of 12 th century, which has suffered notable alterations. One tower on the facade forming a porch, whose construction dates back to the 9 th century. Two towers at both transepts, now destroyed.

Note 10.p.189. Nave of 14 th and 15 th centuries; choir of 15 th. Romanesque tower near the south transept, now destroyed.

Note 11.p.189. Vast church of 16 th and 17 th centuries.

Note 12.p.189. Choir of 11 th century, vaulted anew in the 12 th. Nave without side aisles, of 13 th century, covered by ceiled visible carpentry. This religious edifice, after Notre Dame, is most interesting of those still existing in Paris.

Note 1.p.190. Charming little church of end of 12 th century.

Arr. of Sceaux. Church of Arcueil; church of Vitry; church of Issy; church of S. Maur; church of Nogent-sur-Marne; church of Bagneux.[2]

Note 2.p.190. Pretty church of end of 12 th century; very much injured by modern restorations.

Arr. of S. Denis. Abbey church of S. Denis;[3] church of Bou-

Boulogne;[4] abbey church of Montmartre;[5] church of Suresne; abbey church of Longchamp; church of Charonne.

Note 3.p.190. Crypt of 11 th century. Circuit of choir, chapels of front portion of nave were built by abbot Suger at middle of 12 th century. Choir, transepts and elevated nave built under S. Louis. Old stained glass of 12 th century. Quantity of precious fragments.(See Abbaye de S. Denis, by M. Baron de Guilhermy).

Note 4.p.190. Choir and transepts of 13 th century.

Note 5.p.190. Little church of end of 12 th century. (See Statist. mon. de paris, by M. Albert Lenoir).

SEINE-INFERIEURE, department.

Arr. of Rouen. Cathedral church of Rouen;[6] church S. Maclou do.;[7] abbey church S. Ouen, do.;[8] church S. Patrice, do.; church S. Vincent, do.; church S. Godard, do.; church S. Gervais, do.; church of Mont-au-Malades, do.; abbey church S. Georges of Bocherville;[9] church of Duclair; church of S. Etienne at Elbeuf; church S. Jean, do.; Abbey church of Jumieges;[10] church of Molineaux; church of Yainville; church of Mouppeville.

Note 6.p.190. Circuit of choir of end of 12 th century; nave and choir of 13 th. Transept gables of 14 th. Facade of 16 th. Tower of 12 th, north side of facade; tower of 16 th at south side. This vast church has suffered numerous repairs. (Art. Cathedrale, Fig. 39).

Note 7.p.190. Church of 15 th and 16 th centuries. Pretty plan.

Note 8.p.190. This church can pass as the masterpiece of religious architecture of the 14 th century; only completed in the 15 th.

Note 9.p.190. Norman church of 12 th century.

Note 10.p.190. Ruins from the 12 th century.

Arr. of Havre. Church of Angerville-l'Orcher; church of Etretat; church of Graville-l'Eure; church of Harfleur; church of Lillebonne; church of Montiviller.

Arr. of Dieppe. Church S. Jacques of Dieppe; abbey church of S. Victor; church of Arques; church of Auffay; church of Bourgdun; abbey church of Eu;[11] church of college of Eu; church of Treport.

Note 11.p.190. Curious church, whose choir dates from end of 12 th century, and nave from 13 th. Choir was entirely rebuilt

in 15 th century. Crypt. French style in choir and Norman in nave. (See Arch. des mon. hist.).

Arr. of Neufchatel. Church of Gournay; church of Aumale.

Arr. of Yvetot. Church of Caudebec; church S. Gertrude; church of Valliquerville; abbey church of S. Wandrille;[12] church of S. Wandrille.

Note 12.p.190. Ruins of 12 th century.

SEINE-ET-MARNE, department.

Arr. of Melun. Church of Notre Dame of Melun;[1] church of S. Aspais at Melun; church of Brie-Comte-Robert; church of Champeaux.[2]

Note 1.p.191. Little church with choir without side aisle, with lateral towers. The substructures of these towers and t transepts date from the 10 th century, the nave dates from the 12 th century, and was formerly covered by visible carpentry; choir is of the 13 th century.

Note 2.p.191. Pretty church of beginning of 13 th century. Nave with round windows taking the place of the triforium as above the gallery of Notre Dame of Paris, before the changes made in the 13 th century.

Arr. of Coulommiers. Church of S. Cyr; church of Villeneuve-le-Comte.

Arr. of Fontainebleau. Church of Chateau-Landon; church of Larchant; church of Moret;[3] church of Nemours.

Note 3.p.191. Church with choir dating from end of 12 th c century, without side aisles; circular openings serving for triforium. Transept windows with tracery occupying entire surface of gable wall.

Arr. of Meaux. Cathedral church of Meaux;[4] church of Chauvigny; church of Chapelle-sous-Crecy;[5] church of Ferrieres;[6] church of Othis.

Note 4.p.191. Edifice contemporaneous with Notre Dame of Paris, but almost entirely rebuilt about the middle of 13 th century, then successively repaired during the 15 th and 16 th centuries.

Note 5.p. 19.. Very pretty church of beginning of 13 th century.

Note 6.p.191. Church without transepts; nave lighted by rose windows. Good arrangement of chapels at end of side aisles. Facade now destroyed, 13 th century.

Arr. of Provins. Church S. Quiriace at Provins;[7] church of S. Croix, do.; Church S. Ayoul, do.; church of Dommenarie; church S. Loup of Naud;[8] church of Rampillon;[9] church of Voulton.

Note 7.p.191. Church in good style, from end of 1_ th cent.

Note 8.p.191. church of end of 11 th century. Porch of 12 th, with remarkable stairway.

Note 9.p.191. 13 th century. Sculptured portal.

SEINE-ET-OISE, department.

Arr. of Versailles. Church of Poissy;[10] church of Triel; church of Bougival; church of Vernouillet;[11] church of Thiverval.

Note 10.p.191. Porch and facade of 9 th century; some piers in interior from end of 11 th, nave of 12 th, repaired in 16 th and 17 th centuries; choir of end of 12 th; apsidal chapel of 13 th; chapels of nave and lateral porch from 1_ th. Central tower of 12 th; tower on facade from 12 th, partly rebuilt in 16 th. No transepts. Side aisle enclosing the choir with two lateral eastern chapels from end of 12 th century.

Note 11.p.191. Very pretty church of end of 12 th century, with central tower of 13 th. Square apse. Facade destroyed.

Arr. of Etampes. Church Notre Dame at Etampes;[12] church S. Martin, do.; church S. Basil, do.; abbey church of Marigny; church of Ferte-Aleps.[13]

Note 12.p.191. 12 th and 13 th centuries. Tower with stone spire.

Note 13.p.191. Edifice of 12 th century; tower of same epoch, terminated by a stone spire.

Arr. of Corbeil. Church S. Spire of Corbeil; church of Athis-Mons, abbey church of Longpoint.

Arr. of Mantes. Church Notre Dame of Mantes;[14] church of Houdan; church of Vetheuil;[1] church of Gassicourt;[2] church of Limay; church of Fusiers, church of Richebourg.

Note 14.p.191. Church presents a reduced copy of Notre Dame of Paris, built at a single spurt at end of 12 th century, c choir chapels of 14 th century; towers on the facade from 13 th. Stained glass.

Note 1.p.192. Simple apse without side aisles from 12 th c century; nave of 16 th; pretty Renaissance porch.

Note 2.p.192. Little church with square apse from 13 th century, facade of 11 th; nave of 15 th.

Arr. of Pontoise. Church S. Maclou of Pontoise; church of

Deuil; church of Ecouen; church of Taverny; church of Luzarches; church of Mereil-en-France; church S. Martin at Montmorency; church of Belloy;[3] church of Champagne;[4] abbey church of Royaumont; church of Beaumont-sur-Oise; church of Nesles;[5] c church of Gonesse; abbey church of Maubuisson.

Note 3.p.192. Church very much mutilated; pretty facade of 16 th century, well preserved.

Note 4.p.192. Little church of 13 th century, in an excellent style.

Note 5.p.192. Little church of beginning of 13 th century; lateral tower of 12 th.

Arr. of Rambouillet. Church of Montfort-l'Amaury;[6] church S. Sulpice of Favieres.[7]

Note 6.p.192. Beautiful Renaissance stained glass.

Note 7.p.192. Charming structure of middle of 13 th century; very large openings. Beautiful stained glass.

SEVRES, DEUX, department.

Arr. of Niort. Church Notre Dame of Niort; church of Champdeniers; church of S. Maixent;.

Arr. of Bressuire. Church of Bressuire; church of Oyron; c church S. Denis at Thouars.

Arr. of Melle. Church S. Pierre at Melle;[8] church S. Hilaire, do.;[9] church S. Savinien, doa; church of Celles; church of Javarzay.

Note 8.p.192. Pretty church of 12 th century.

Note 9.p.192. Of 12 th century. Beautiful style of Poitou.

Arr. of Parthenay. Church S. Laurent at Parthenay; church S. Croix, do.; church Notre Dame de-la-Couldre, do.; church S. Pierre at Airvault; church of S. Generoux; church of Marnes; church of S. Louis of Marnes, church of Parthenay-le-Vieux;[10] church of Verrines-sous-Celles.

Note 10.p.192. All these churches belong to the best style of Poitou, 12 th century.

SOMME, department.

Arr. of Amiens. Church Notre Dame (cathedral of Amiens);[11] church Notre Dame of Araines; church of Namps-au-Val; church of S. Denis-de-Poix.

Note 11.p.192. Edifice entirely rebuilt during 13 th century. (Art. Cathedrale, Figs 19, 20).

Arr. of Abbeville. Collegiate church of S. Wulfram of Abbe-

Abbeville;[12] Abbey church of S. Riquier;[13] church of Rue.

Note 12.p.192. Edifice built at beginning of 16 th century. The single nave has been raised.

Note 13.p.192. 16 th century.

Arr. of Doullens. Church of Beauval.

Arr. of Montdidier. Church of Ailly-sur-Noye; abbey church of Bertheaucourt; church of Folleville; church of S. Pierre of Roye; church of Tilloloy.

TARN, department.

Arr. of Alby. Church S. Cecile (cathedral of Alby);[1]

Note 1.p.193. Church with single nave without transepts, w with chapels, built of brick; 14 th and 15 th centuries. (Art. Cathedrale, Fig. 50). Paintings of the epoch of the Renaissance.

Arr. of Castres. Church of Burlatz.

TARN-ET-GARONNE, department.

Arr. of Montauban. Church of Caussade;[2] church of Montpezat;[3] church of Varen.[4]

Note 2.p.193. Tower of 14 th century.

Note 3.p.193. Church with single nave and without transepts; 14 th century.

Note 4.p.193. Church of 12 th century with two twin apses.

Arr. of Castel-Sarrazin; church of Beaumont-de-Lomagne; abbey church of Moissac.[5]

Note 5.p.193. Narthex of 11 th century, in three stories; porch of 12 th; nave of 14 th, without side aisles and without transepts.

VAR, department.

Arr. of Draguignan. Cathedral church of Frejus; abbey church of Thoronet;[6] church of Caunet; church of Luc.

Note 6. Cistercian church of 12 th century, of great simplicity. (See arc. des mon. hist).

Arr. of Brignoles. Church S. Maximin.

Arr. of Grasse. Church of Vence. (Old cathedral).

Arr. of Toulon. Church S. Louis at Hyeres; church of Sollies-Ville; church of Sixfours.

VAUCLUSE, department.

Arr. of Avignon. Church Notre Dame-des-Doms (cathedral of Avignon);[7] church of Cavaillon (old cathedral);[8] church of Thor;[9] church of Vaucluse; abbey church of Senanque.

Note 7.p.193. Edifice of 12 th century, but unrecognizable

Note 7.p.193. Edifice of 12 th century, but unrecognizable because of the mutilations it has suffered.

Note 8.p.193. Church of 13 th century, which has retained all the characteristics of the Romanesque architecture of Provence.

Note 9.p.193. Very delicate architecture in which one feels the immediate enfluence of Roman arts.

Arr. of Apt. Church of Apt (old cathedral).

Arr. of Carpentras. Church S. Siffrin at Carpentras; church of Purnes; baptistery of Venasque;[10] church of Caromb.

Note 10.p.193. Edifice of 8 th or 9 th century, vaulted; r resembling a very small hall of the antique baths, but of very coarse construction.

Arr. of Orange. Church of Vaison (old cathedral); church of Valreas.

VENDEE, department.

Arr. of Fontenay. Church of Fontenay-le-Comte; church of Maillerais; abbey church of Nieuil-sur-Authise; church of Vouvant.

VIENNE, department.

Arr. of Poitiers. Cathedral church of Poitiers;[11] church of Notre-Dame-la-Grande at Poitiers;[1] church of Moustier-Neuf; abbey church of S. Hilaire, do;[2] church of S. Radegunde, do;[3] church of Fontaine-Lecomte; abbey church of Liguge; church of Nouaille; church of Lusignan.

Note 11.p.193. Church built at end of 12 th century according to the Romanesque traditions of Poitou, but with forms a already Gothic. Beautiful construction. Simple plan. (Art. Cathedrale, Figs. 44, 45). Facade of end of 13 th century.

Note 1.p.194. 11 th and 12 th centuries. Facade of the latter epoch, entirely covered by sculptures. paintings in the interior.

Note 2.p.194. Church of 11 th century, formerly vaulted in domes, now much mutilated. Beautiful plan, vast and well conceived.

Note 3.p.194. Church of 13 th century. Paintings in the interior, restored recently. Crypt.

Arr. of Civray. Church S. Nicolas of Civray; abbey church of Charroux;[4]

Note 4.p.194. Vast church terminated by a rotunda, 12 th

century, now in ruins. (Art. Saint-Sepulchre).

Arr. of Montmorillon. Church of Montmorillon; church of Antigny; church S. Pierre at Chauvigny; church Notre Dame, do.: church of la Puye; abbey church of S. Savin.[5]

Note 5.p.194. Porch of 9 th century! nave of 11 th; choir of beginning of 12 th. Spire over porch from 15 th century. Paintings in the interior from 12 th century. (Art. Architecture Religieuse, Figs. 11, 12). Style Romanesque of Poitou.

, VIENNE, HAUTE, department.

Arr. of Limoges. Cathedral church of Limoges.[6]

Note 6.p.194. Porch of 9 th century, ruined nave of 11 th; choir of 13 th and 14 th; transepts of 15 th.(Art. Cathedrale, Fig. 47).

Arr. of Bellac. Abbey church of Dorat.[7]

Note 7.p.194. Beautiful church of 12 th century. Mixed style of Auvergne and of western coasts.

Arr. of Rochechouart. Church of Rochechouart; church of S. Junien; church of Solignac.[8]

Note 8.p.194. Style of Perigord. 12 th century. Domes.

Arr. of S. Yriex. Church of S. Yriex.

VOSGES, department.

Arr. of Epinal. Church of Epinal.

Arr. of S. Die. Cathedral church of S. Die;[9] church of Moyenmoutier.

Note 9.p.194. Nave from 11 th century, repaired in 12 th. Square apse of end of 13 th century.

YONNE, department.

Arr. of Auxerre. Church S. Etienne at Auxerre (old cathedral);[10] church S. Pierre, do.; church S. Germain, do.;[11] church S. Eusebe, do.;[12] church S. Florentin, do.;[13] abbey church of Pontigny;[14] church of Chitri-le-Fort; church of Moutiers; church of Chablis; church of Vermonton; church of Mailly-le-Chateau.

Note 10p.194. Beautiful Burgundian choir of 13 th century, with a single square chapel in the chevet. Transepts and nave of 14 th and 15 th centuries. Lower parts of the facade from end of 13 th century; upper parts of 15 th. Glass. Crypt of 9 th century. Paintings in the crypt.

Note 11.p.194. Crypt from 9 th century, much mutilated; choir of end of 13 th; nave destroyed. Tower of 12 th century.

Note 12.p.194. Nave of 11 th century, much mutilated. Facade of 13 th; choir of 16 th. Stained glass. Tower of 12 th cent.

Note 13.p.194. Choir of 16 th century. Stained glass.

Note 14.p.194. Great church of order of Citeaux. Nave of 12 th century, with porch; choir from beginning of 13 th.(Art-. Architecture Monastique, Fig. 3).

Arr of Avallon. Church S. Lazare of Avallon; church S. Martin, do.; abbey church of S. Madeleine at Vezelay;[1] church of S. Pere sous Vezelay;[2] church of Civry; church of Montreal;[3] church of Pontaubert.[4]

Note 1.p.195. Great church of order of Cluny. Nave of end of 11 th century; closed narthex from 12 th; choir and transepts of end of 12 th century;. Four towers formerly. This church is at the head of the great school of Burgundy.

Note 2.p.195. Pretty little church of 13 th century; style pure Burgundian. charming tower. porch open, built in 13 th centurn and partly rebuilt in 14 th. Choir of end of 14 th. Three radiating chapels. No transepts.

Note 3.p.195. One of the purest churches of the Burgundian style of end of 12 th century; built at one spurt. Square apse, flanked by two square chapels. Transepts. Gallery.

Note 4.p.195. Little church of 12 th centuru in pure Burgundian style.

Arr. of Joigny. Church S. Julien-du-Sault;[5] church of Villeneuve-le-Roi;[6] church of S. Fargeau.

Note 5.p.195. Stained glass of 13 th century.

Note 6.p.195. church of 13 th century. Mixed style of Burgundy and of Champagne.

Arr. of Sens. Church S. Etienne (cathedral of Sens);[7] church of hospital of Sens;[8] church Ss. Savinien and Potentin, do..

Note 7.p.195. Church from middle of 12 th century, originally without transepts, almost entirely rebuilt in 13 th. (Art. Cathedrale, Fig. 30).

Note 8.p.195. Choir of 13 th century. Mixed style of Champagne and of Burgundy.

Arr. of Tonnerre. Church S. Pierre of Tonnerre; church of Hospice of Tonnerre;[9] church of Neuvy-Saultour.

Note 9.p.195. Great church with a single nave covered by c carpentry, with little vaulted apse; 13 th century.

EGOUT. Sewer. Drain.

EGOUT. Sewer. Drain.

A subterranean conduit of masonry designed to carry off rain and waste water. The Romans were great builders of sewers, and when they built a city, they first thought to establish these subterranean services. When the barbarians became possessors of gallo-roman cities, they did not think of maintaining the ancient sewers, which were soon clogged or lost; the cities then contained actual cesspools, the stagnant water t then penetrated into the soil, the streets were infected, and pestilence periodically decimated the people. Men commenced by opening trenches in the middle of the principal streets, deep and walled streams, which were covered by slabs or left open. Storms had the care of cleansing these deep channels encumbered with deposits of all sorts. It was scarcely in the 12 th c century that men returned to the ancient system, and constructed sewers of masonry under the principal streets of cities. Corrozet speaks of sewers found opposite the Louvre, when that palace was rebuilt in 1538. There existed beneath the university quarter of Paris sewers Sprobably Roman), that were long utilized and rebuilt in 1412 (Sauval), because they were beyond service. We have frequently seen in making excavations of the vicinity of edofices of the middle ages remains of sewers constructed bo beautiful cut stones. The religious establishments and the feudal castles were already equipped with well arranged and constructed sewers after the end of the 12 th c century. It frequently occurs, that these sewers are practicble for men. When mansion Tremoille at Paris was demolished in 1840, there was discovered in the gardin a primary sewer, that seemed very ancient, and that presented the section indicated in Fig. 1. That sewer was traversed by another more modern (probably of the 12 th century;2), which was composed of a series of round arches, on which rested very thick slabs. These slabs were worn as if they had been long exposed to the passage of wagons, horses and persons on foot; they were on a level with a pavement of small blocks of sandstone. Under the palace of justice of Paris and beneath the site of the o old palace of the bishop, there still exist sewers that date from the epoch of S. Louis and of Philip the Fair. They are built of hard stone with great care and are covered by round tunnel vaults, paved with slabs at the bottom with a width of

about 2.5 ft. However sewers were rare in the cities of the middle ages compared with the number and extent of the streets, they were scarcely constructed except beneath the principal streets ending at rivers, with openingr at the level of the ground to water of the streams entering these streets at right angles.

EMBRASURE. Embrasure. Porthole.

An opening pierced in the wall of a fortress or in a crowning parapet for placing the mouth of a cannon. Embrasures then only appear in military architecture at the moment, when a regular use was made of cannon for defense of places. We have said elsewhere (Art. Chateau), that at the end of the 15 th century without notably changing the general arrangement of the defenses; men were content to pierce in the ground story of the curtains of towers openings for striking the exterior by a sweeping fire, or to place guns at the tops of towers, whose roofs were suppressed to establish platforms with parapets. The castle of Bonaguil, which dates from the reign of Louis XI, possesses at the base of the ramparts some embrasures whose arrangement and form are indicated in Fig. 1. The muzzle of the gun is nearly at the middle of the thickness of the wall, as shown by the plan A. At the interior of the wall B, the embrasure is arched and is closed by a thick slab pierced by the round hole with a sight opening. On the exterior C is seen only the hole of sight opening with a splay allowing the gun to be pointed to right or left. The outer part of this sort of embrasure was rapidly injured by the blast of the gun; thus men thought of giving it more space (2), covering the external splay by an arch. Or indeed also as in the casemate batteries of the great rampart of Schaffhausen (3), the architects advanced the mouth of the cannon nearly to the external surface, forming inside a vaulted chamber, arrangiug the external splays in oval form with curved recesses, to turn aside the projectiles thrown by the assailants. These precautions in detail could only be efficient while the enemy did not place in battery great pieces of artillery, and had at his disposal only muskets or very small guns. Yet these kinds of embrasures were employed also for covered batteries until the beginning of the 16 th century.[1]

Note 1.p.198. Art. Boulevard, Fig. 5., an embrasure arranged for oblique fire, with reserved piers intended to protect the artillerists.

Military architects sought combinations, that could facilitate oblique fire at the same time that they protected the men serving the guns; but the artillery made rapid progress. At the beginning of the 16 th century, besieging armies already possessed cannon of great calibre, that one shot ruined such too weak defenses, for it is stated, that from the moment when artillery became in general use, defensive means were inferior to the ever increasing power of that arm. One should not be surprised if the first fortifications built to resist cannon present a singular variety of defensive means, all very ingenious and very subtle, but soon abandoned as insufficient, to be replaced by others scarcely less so. Thus in the fortifications built by Albert Dürer at Nuremberg, we see embrasures of covered batteries (4), that permit pointing a cannon and obtaining a plunging fire and oblique fire for musketeers.

At Munich exists on the front of the brick gate Carlsthor, that dates back to the beginning of the 16 th century, embrasures arranged for an oblique and plunging fire (5), intended for small guns. At the Laufer gate of Nuremberg, along the external rambart one notices still embrasures designed for small cannon, whose openings are protected by small wooden cylinders, pierced by holes, like the battlements of one of the gater of Basle in Switzerland. (Art. Creneau).[1] In France these crafty means, a tradition of the military arts of the middle ages, were quickly set aside; men adopted by preference for covered batteries deep embrasures, fresenting a small open angle, leaving only a hole for the muzzle with a sight, on the exterior showing only a wide hole occupying the height of a course (7), sometimes with a bottmo slope when a plunging fire was desired. That method was habitually followed in Italy from the first y years of the 16 th century.

Note 1.p.200. A gives the plan of the embrasure, B its internal elevation, C the horizontal section of the wooden cylinder, and D its form and dimensions.

As for the embrasures of batteries not covered, Albert Dürer built those at Nuremberg as indicated by Fig. 8 in the curtains of some of his ramparts. The wide stone parapet presents

a convex surface to better resist the effect of hostile projectiles. A shutter pivoted on an axis protected the gunners while the gun was loaded. Those shutters were sufficiently t thick and solid, that balls coming horizontally woud bound on its upper surface, for then the direct fire was weak because of the bad quality of the powder and the bad proportions of the guns, the chamber being too large a diameter for the load employed.

Sometimes in France and Intaly men had the idea of making t the embrasures as indicated in Fig. 9, in order to prevent hostile balls from sliding on the surfaces of the splays, and st striking the gun. It is unnecessary to state that these angles were quickly destroyed by the artillery of the besiegers, and even changed by the blast of the cannon. From the epoch of F Francis I, when it was desired to arm a fortress, men came to crown the ramparts and curtains by earth slopes mixed with p pieces of wood of straw. In case of siege embrasures were opened in this slope (10), and their vertical surfaces were maintained by planks. This method is still followed in our days. If necessary the height of the parapet was increased by gabions of bags of earth. Sometimes even these parapets with their embrasures were made of triangular wattlework placed together, and filled with earth and rubbish (14). These means were particularly employed for works in campaign built in haste, when men did not pile up terraces.

As today, military engineers were occupied in masking embrasures while the guns in battery were loaded. For that purpose were employed thick hurdles, shutters sliding in grooves, or low curtains. Ol all these means, that most ingenious is that given by us (12). At A is seen the wooden platform covered by planks on whilh rolls the gun in battery. Against the internal surface of the parapet is placed the frame B, furnished in its upper part with a triangular shutter swinging on an axis, and moved by two levers C. The gun being loaded, men pulled on these levers when it was necessary to aim; as soon as the ball started, the shutter was dropped and by its own weaght resumed the vertical position.

Embrasurer have in all times greatly occupied architects and military engineers, and after many experiments they have always returned to wickerwork, to earth forms for batteries not covered.

As for embrasures of covered batteries or casemates, no system has yet been found that offers guarantees of durability against siege batteries, and since the 16 th century the art of fortification in that respect has not made sensible progress.

ENCEINTE. Enclosure. Wall. Palisade.

Palisade enclosures surrounding a city, market town or camp. According to Cesar, the Gauls built the enclosures of cities, villages or fortified camps, by means of trunks of trees mixed with stones. The Germans composed them of wooden palisades between which were heaped earth, branches of trees and grass, so as to form an actual wall well adapted to resist the effects of the batterenç ram; even fire had little effect on these works, almost always wet. The Romans in their winter camps (permanent camps) employed nearly the same procedure, or contented themselves with a bank of earth crowned by a palisade and externally protected by a ditch. The gates of these camps were usually protected by a sort of advanced work,(clavicula), much resembling the barbicans of the middle ages (1). At A were wooden bridges over the ditch, and at B the gate of the camp. This combination of stone and wood employed in the enclosures of cities or Gaulish camps gave the idea to some peoples of this country to obtain vitrified ramparts, consequently of complete durability and coherence. There exists at 17.5 miles from S. Brieuc an oval enclosure composed of granite, clay and trunks of trees, that they succeeded in vitrifying by setting fire to the wood after having surrounded the intrenchment with fagots.

We give at (2) a section of that enclosure, called of Peron. They commenced by making a wall of pieces of granite mixed with trunks of trees A; on the exterior this wall (vallum) was covered by a layer of clay B, and the whole must have been covered by a considerable quantity of fagots to which fire was set; the granite was vitrified and melted together; the clay has formed a solid mass adherent to that vitrified mass; a ditch and little wall of earth C protect the exterior of that singular enclosure. We know no other example of this kind of intrenchment in France; it is claimed that some exist in Ireland and in the north of Scotland.

In the first times of the middle ages, many cities in France

only had enclosures of wood. At the epoch of the invasions of the Normans was to be seen a great number of them, to which the barbarians evidently set fire. Men then in a manner replaced these fragile defenses by masonry walls; but the firce of habit and the facility with which wood could be procured in great quantity caused that for a long time many cities in the north were only enclosed by palisades of wood with or without terraces. When once they built masonry walls in the 11 th and 12 th centuries, wood still filled a very important place in these defenses, either to equip their tops, or to form external enclosures outside the ditches, before the gates, bridges and the exteriors of suburbs.

During the wars of the 15 th century there is frequent mention of market towns simply defended by enclosures of palisades. "And then they came to Pierrepont and took the city," s says Pierre de Fenin,[1] "that was enclosed by palisade and ditches." Froissart [2] also speaks of several cities with enclosures in his time, only composed of palisades with wooden sheds and ditches.

Note 1.p.208. Memoire. Collection Michoud. Poujoulot. Vol.2. p. 614. (1422).

Note 2.p.208. Book II. The cities of Grovelines, S. Venont in Flanders, Berghes, Bourbouch, are mentioned by this author as being enclosed only by palisades and ditches.

Many cities during the middle ages were open, for to enclose them it would have been necessary to obtain the permission of the sovereign, and as the construction of these enclosures w was customarily at the cost of the citizens, the urban population was not always rich enough to incur such great expense. In time of war the cities were enclosed in haste to protect themselves from a sudden attack or to serve as a support for an army corps. (Old French text).[1] Just as the Roman armies and the western armies of the middle ages built walls around their camps, when they desired to hold a subject province, or to have a base of operations.(Old French text).[2] The wooden enclosures built outside the walls of strong places were designated in the 13 th century by the name of "fors rolleis,"[3] of "forclose,"[4] and later by palisade or barrier. The free s spaces left between these outer enclosures and the masonry walls were called the lists.

Note 1.p.207. Hist. du ducs de Normondie et des rois d'Angleterre, from two monuscripts of Imp. Lib. (13 th century). Pub. by Soc. d.l.hist. d. France. 1858.

Note 2.p.207. Gerord de Roussillon. Edit. of beginning of 16 th century. Lyons. Reprint at Lyons. Louis Pessin. 1858.

Note 3.p.207. Li Romon de Gorin. Vol. I. p. 231. Edit. Techener. 1833.

Note 4.p.207. The some. Vol. II. p.172.

An enclosure of a city was not regarded as very strong only when it was double; when they could not construct two walls flanked by masonry towers, they at least arranged palisades w with ditches before the masonry enclosure, yet so that the internal wall could always command that external enclosure, and that it was distant only a short shot of a crsssbow. If the external enclosures were of masonry, flanked by towers and f furnished with barbicans, these towers and barbicans were open on the side next the city, open at the gorge,as it is now said, so as to prevent the besiegers from establishing themselves there after taking possession of them.

When one desires to consider the means of investment and of attack of strong places in the middle ages, it is perfectly evident of what value were the outer enclosures; thus was attached to them great importance. Between the two enclosures, a garrison had entire freedom of action to defend itself, to bring in assistance, or to take the offensive by making sorties. In the lists the besieged troops felt a strong protection behind them, they could throw themselves in mass on points attacked while relying on the internal walls, from which by their height men directed their efforts or protected their r retreat. Thus in the lists were placed their great war machines to compel the assailants to make works of approach, slow and hard to push forward on a stony soil. If the enemy took possession of a curtain or an external tower, the besieged fortified the lists by establishing two traverses at right aud left of the attack, that could prevent the besiegers from approaching the inner enclosure. (Arts. Architecture Militaire, Barbacane, Chateau, Porte, Siege, Tour).

In the cities were frequently found several adjacent enclosures, as well as most cloisters of cathedrals; castles, palaces and even certain quarters were enclosed by walls, and th their gates were closed at night.

ENCLOSURE. Wall. Palisade. (Art. Cloture).

ENCORBELLEMENT. Corbelling. corbel.
System of construction in stone or wood formed of superposed corbels, and that permits supporting a load overhanging the face of the wall, pier or buttress. One says construction by corbelling to designate a structure placed on a corbelling. (Arts. Construction, Figs. 40, 81, 82, 96, 101, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137; Echauguette; Machicoulis.

ENDUIT. Coating. Plastering. Stucco.
A covering of mortar, plaster or lime putty, placed on masonry of rubble, brick, even sometimes on cut stone, to obtain a uniform and homogeneous surface, suitable to receive paint.
The Greeks placed coatings on all their structures, exteriors as well as interiors, unless they were made of white marble. Also they colored the last material to avoid the cold and uniform surface of a single color, and to distinguish the different architectural members. The coating placed on their structures of cut stone, however well dressed they were, is very thin, (.004 or .008 in.), and is always colored.[1] All the joints and beds of the structure were thus concealed under this light covering. The Romans excelled in the art of preparing and applying coatings. Great edofices as well as private houses were constructed of bricks and concrete, and they faced their external and internal surfaces with slabs of marbel and plaster in several layers, a thick one first, then a thinner and at last very thin one, well smoothed, polished and covered by paintings. In the first times of the middle ages men desired to imitate this procedure; but the barbarians did not know how to make good lime, and knew still less about using it. Hence the plastering found on some rare monuments of the Merovingian and Carlovingian epochs is friable, blown and badly smoothed. Only in the 12 th century was plastering done with care; yet it is not to be compared to that of the Romans.
It must be stated that the syutem of construction adopted by the architects of the middle ages did not accept plastering, except on rough rubble; these architects after the 12 th century but exceptionally placed plastering on cut stone, that must be painted and allowed to show its surface. On the intra-

intrados of vaults made of rough rubble, like those of the edifices of Burgundy and the centre, on filling walls between engaged fiers, was plastering applied, and then it was always covered by painting. (Art. Peinture).

In houses and interiors of castles however, they spread a very thin coating, even on cut stone. Thus were finished the walls of the castle of Coucy, that date from the beginning of the 13 th century, so as to conceal the joints and to place the painting on smooth surfaces. But these coatings, quite similar to the Greek stucco, are only a thick coat of lime and very fine sand laid with the brush and compressed by means of a small float. The colors were applied on this coating while it was still damp, then waxed and heated when the whole was perfectly dry; a procedure that recalls the monumental painting of the ancients. From the 12 th century in interiors were employed coats of plaster, either on masonry walls, or on half timber work as partitions. These coats of plaster are generally very firm, very thin and placed on backing of plaster into which always enters coarse sand. We have seen such plastering that had acquired extreme hardness, the plaster showing a great number of glistening particles at a fracture.

Note 1.p.208. The Grecian stone temples of Sicily and Paestum have retained numerous traces of an extremely fine stucco, that appears to be composed of lime and marble dust.

The coatings of lime putty were made and are still made of lime, fine sand or stone dust with the hair of cattle. When not exposed to dampness and applied to a good ground, this stucco lasts a long time; but it never acquires hardness. It has no advantage except not costing dear and being very light.

ENFER. Hell. Hades.

The abode of the damned is usually represented in paintings and sculptures of the middle ages by a monstrous mouth in which the condemned are swallowed. In the office of the dead is read this passage:- "Free me, Lord, from eternal death, from the infernal hand, from the mouth of the lion," etc. The early artists translated the text literally. On the lintel of the principal portal of the cathedral of Autun, which dates from the 12 th century, is indeed seen in the last judgment beside the damned, two hands that grasp one resurrected. As

As for mouths denoting the entrance to hell, they are found on a number of reliefs and paintings. The idea of the classification of the damned in hell by kinds of punishments according to the causes of condemnation is an idea, whose trace is found very early in the monuments of the middle ages, and Dante has only given those traditions a poetic form, that summarizes in his work all that western artists have painted or sculptured on religious monuments. Indeed in the edifices of the 11 th and 12 th centuries, we see avarice, luxury, pride, idleness, etc., suffering in hell punishments proportioned to these vices. The avaricious are bent under the weight of bags of money hung on their necks; those that have abandoned themselves to the pleasures of the senses are devoured by obscene animals; the proud are driven at a gallop; toads attach themselves to the lips of calumniators, etc. (Arts. Jugement Dernier; Vices).

ENGIN. Engine. Machine.

This name is given to all machines; from this come the words engineer and machinist to designate the men charged with making, use and erection of machines, therefore the name engineer is given in our days to every person occupied with the erection of bridges, laying out roads, construction of shops, machines, ships, fortifications, etc.; also the name of engineering is given to the service.

Among the engines of the middle ages are machines employed for civil service, such as machines for hoisting or transporting burdens, cranes, crabs, windlasses, hydraulic machines and presses, then war engines, which are divided into machines for offense, for defense, and those for both offense and defense.

It is certain that the Romans possessed powerful machines for transporting and hoisting the enormous materials, that th they so frequently placed in their structures. Vitruvius gives us on this subject only limited and very vague information. The Greeks were very advanced in the mechanic arts; which cannot be surprising if one thinks of the knowledge, that they had acquired in geometry at a very ancient epoch, and that th they perhaps derived from the Phoenicians. Since antiquity t the mechanical powers have not advanced a step; only the applications of those powers are extended, for the laws of mechanics

are derived from geometry; these laws do not change after being once known; and among to many things here, that are given as truths, these are the only ones that cannot be doubted.

The ancients knew the lever, wedge, screw, inclined plane, windlass and pulley: as motor force they employed only the strength of man, that of the beast of burden, currents of air or water, and weight. They had no need like us, to economize the strength of men, since they had slaves, and they were ignorant of the modern forces produced by steam, expansion of gases and electricity. The middle ages inherited the knowledge left by the ancients without adding anything to it, until the epoch when the lay minds took the lead in the arts and sought new methods, at first by multiplying the known powers, and then by endeavoring to find other motive forces. Just as in seeking the philosopher's stone, the alchemists of the middle ages made precious discoveries, and the mechanicicians a and geometers while seeking perpetual motion, the aim in their labors, solved interesting problems, that were unknown before them or perhaps forgotten; for we are disposed to believe that the Greeks being endowed with a marvellous activity of mind, the motive forces of their time alone being accepted, had carried the mechanic arts as far as possible.

ENGINS APPLIQUES A LA CONSTRUCTION.

Engines applied to construction.

We see in the manuscripts, reliefs and paintings of the 9 th to 12 th centuries, the wheel and axle, gear wheel, steelyard, the various applications of the lever and inclined plane. We cannot exactly determine the epoch of the invention of the jack, but already in the 14 th century its principle is entirely adopted in certain war machines.

Further, everyone knows the principle of mechanics,viz:- that the amount of movement of a body is the product of its mass by its velocity, i.e., the space passed over in a given time; once that this principle was recognized, the different applications must naturally follow with more or less skill. In Romanesque structures, one rarely sees any but little materials employed, materials that were carried either on the shoulder, on a barrow by means of pulleys, or by employing the wheel and axle that laborers turned by their weight.(1). That primitive machine is still employed in certain depart-

departments of the Centre and West of France; it is powerful when the wheel has a diameter of 23 ft, like that drawn in t this example, and that can be turned by the weight of three men; but it has the inconvenience of occupying much space, is difficult to transport, and it does not allow regulation of the movement of hoisting, as can be done with the machines of our time employed for the same purposes. The only means of g giving great power to the motive forces formerly known was to multiply them by the lengths of levers. Thus during the middle ages and in antiquity, the lever played the principal part in the manufacture of machines. The Romans had hoisted blocks of stone of enormous volume to a great height, and they daily set up monolithic columns of granite or marble 6.6 ft. diameter at the base by 49.2 to 59.1 ft. in height. The Phoenicians and the Egyptians had done much before them; now such results could only be obtained by the power of the lever and the very extended and perfected applications of this primitive m means.

For example, one understands what power a machine might have if arranged like this. (2). Let A B be a monolithic column p placed on an inclined bed with at C an axis rotating in a longitudinal groove sunk in a great block of wood E, that is fastened in X when the bed is in place; fastened on the axis of the inclined timbers, let there be two shears C D, connected at their top D, as shown by the sketch P' let there be wooden shores G, then a system of rope shrouds H strongly fixed by keys; let there be along the shears the pullies K', and on t the ground and fixed to the two longitudinal timbers other c corresponding pulleys L, the latter sending the cables to two capstants placed at a distance. It will be necessary for the monolith A B, however heavy it may be, to describe the circular arc and take the position a b; below its lower bed will be placed small blocks or a good bed of mortar, and gradually s slacking the cords holding it, it will slide on the timbers and set itself on its base M. It is only necessary to have shears of dimensions proportioned to the height of the block to be raised, and a number of pullies or tackles corresponding to the weight of the block. This is the same principle that was adopted from time immemorial in the construction of l little drays (2 bis) suitable for raising and transporting g

great wooden timbers.

But is very rare for the architects of the middle ages to use monolithic columns of dimensions to require such means. To erect monolithic columns like those of the cathedral of Mantes, the church of Semur-en-Auxois, choir of Vezelay, cathedral of Langres, etc., the architects could only employ t the lever windlass, that we have seen represented in stained glass and the vignettes of manuscripts. This lever windlass, in spite of its volume, could be transported on rollers, and if it only concerned hoisting the columns of a sanctuary, it was only necessary to move it to place its axis normal to the curve of the chevet.1

Note 1.p.214. The engineers of the middle ages were not embarrassed in moving enormous carpentry works after being pinned together; we shall have proof of this immediately.

Here (3) is one of these machines that we have endeavored to make practical, for the sketches given in the old paintings are so naive, that one must regard them as a conventional indication, a sort of hieroglyph. At A is seen the plan of the machine, whose horizonta, windlass B is so arranged as to be able to coil up two ropes. The elevation D of this machine shows one of the two circular disks C of the plan, which have on each of their faces eight movable teeth, whose detail is presented at G in side and front. The great levers E are forked and straddle the vertical disks, left to themselves, these levers take the position K L, their ends striking the crossbar L because of the counterpoise I. Then the teeth M falling to the lower part of their gain by their own weight and the position of their axes, oppose a stop to the end of the lever at the fork; the men have ascended the ladder N, placing their feet on the crossbar O and pulling on the rods, as indicated by the person sketched on our elevation, make the end of the lever descend to O′. The disk has thus made one-eighth of a revolution, and the ropes are coiled on the axle. leaving the crossbar O, the lever rises to its first position by the action of the counterpoise; the men ascend to place themselves on the crossbar, and thus continue. The ladder N of the crossbar O occupies the entire width of the machine between the two l levers, and at least six men could place themselves on that crossbar as indicated by the detail P, and give to the levers

a very considerable power, because these men not only act by their weight, but by lifting on the rounds. In the detail G we have sketched at R one of the teeth dropped, and at G is the corresponding tooth raised. This sort of movable gearing, opposing a resistance in one direction and annulling this in the other, assuring their function of a tooth by the position of the wheel, are very common in the machines that Villard of Honnecourt gives in several examples of them, among others in his wheel with unequal hammers, by means of which he claims to produce rotation without the aid of any outside motor force.

The screw jack, that machine composed of strong horizontal timbers through which pass two great wooden screws, with a v vertical frame connecting them, was employed during the middle ages to raise very considerable weights, and must have preceded the jack. Villard of Honnecourt gives on of these machines,[1] whose power is superior to that of the jack, but it is also much more bulky (40). A great vertical wooden screw is terminated at bottom by a capstan, passes through the timber A and turns by means of pivots fitted in the sill B and the cap C; two inclined timbers connect together the three horizontal timbers. Two vertical slides D receive, as in section E, a great wooden nut armed with iron hoops supporting a ring with its lewis F. By turning the capstan, the nut is necessarily raised between the two grooves of the slides D, and thus one can raise enormous burdens, if the machine be of sufficiently great dimensions.

Note 1.p.216. Plate XLIII. See in the English edition of t the Album of Villard of Honnecourt, London, 1859, a fine description given by M. Willis of that machine. See French edition; Album de Villard de Honnecourt. Delion. 1858.

The use of inclined planes was very frequent in the structures of antiquity and of the middle ages; we have given a remarkable example of this in Art. Echafaud, Figs. 1, 2. Thus is avoided the danger of breaking cables in a time when iron chains were not employed to raise materials of great volume, and men did not need to use extraordinary motive powers. It is certain that by means of a plane inclined at 45°, for example (5), two pulleys being placed at the top A, two other p pulleys at D, and one or two capstants at D, the weight C being placed on rollers, much force is saved; but it is unneces-

unnecessary to state that this mode of raising materials suitable for construction can be employed only while the buildings attain a very moderate height; now edifices of the middle ages are often very high. Then for the construction of the upper work of these edifices, it appears that they employed the crab and the crane. There still existed at about the beginning of our (19 th) century on the south tower of the cathedral of Cologne, then carried about to the level of the high vaults of the nave, a crane carefully covered with lead, that dated from the 14 th century, i.e., from the moment at which the works were stopped. We posses no certain documents relating to that curious machine; we know only its general form, that recalls that of cranes still employed during the last (18 th) century. The materoals were brought to the foot of the work beneath the end of the crane by means of great drays with two wheels, as indicated by Fig. 6. A long tongue serving as a l lever, when the stone had been loaded on the platform A, permitted the raising of the platform by lowering the end B, and to roll the machine to the point at which the caple of the c crane could take the stone by means of the lewis.

These machines are still in use in the provinces of the South. Not more than 20 years since notable improvements were made in the system and manufacture of machines employed in construction; until then the machines used in the 13 th century were still used to transport materials from one point to another, or to hoist them vertically. The crab, that admirable and simple invention, that dates back to the highest antiquity, is still in use today, and it is probable that it will be employed for a long time.

ENGINS DE GUERRE. War Machines.

It is necessary to make our text clear by dividing machines according to their functions:- machines for attack, for attack and defense, and for defense alone.

Offensive machines before artillery. -- Vitruvius[1] speaks of three machines suited for attack; catapults, scorpions and balistas. catapults and scorpions are placed by him in the s same list; these machines were inteuded to throw darts of great length and considerable weight. Naturally the dimension o of the projectile gives that of the machine. The propelling motor consists of wooden springs strained by means of ropes

and windlasses. Unfortunately Vitruvius, who gives us the r relative dimensions of each part of these machines, forgets to describe their construction; so that it is difficult to o obtain a tolerably accurate idea of the system adopted. Perrault in his translation of the Latin text gives a represeutation of a catapult;[2] but we confess to not being satisfied by his interpretation. His motor could have but a very weak action, and would rather make the arrow wabble than send it in a straight line. Vegetius [3] speaks of ballistas, onagers, scorpions, and ballistas with bows; but his descriptions are of a brevity, that one can derive from them nothing conclusive; we only know from him that the ballista was bent by means of cords or sinews, that the scorpion was a ballista of small d dimensions, a sort of crossbow; "scorpions were what are now called hand ballistas;" that the onager cast stones, and that the strength of sinews must be calculated according to the w weight of the projectiles; but he avoids informing us if these onagers were machines set in action by counterpoises, stretched cords or springs. Commentators on these ancient authors a are more prolix as the texts are more brief or obscure; but they give us no practical solutions.

Note 1.p.219. Book,X. Chaps. 15, 16.

Note 2.p.219. Plate 64.

Note 3.p.219. De re militari. Book IV. Chap. 22.

If Vegetius seems to indicate that the ballista was a great fixed crossbow suited to discharge arrows, Vitruvius claims that the ballista was intended to cast stones of a weight varying from 200 to 250 lbs.; he does not inform us whether the machine was moved by counterpoises or springs. The ballista g given by Perrault sent its projectile ten paces, if it did n not even fall on the carriage. Amminanus Marcellinus [4] is a little less obscure in the descriptions he has left to us of the offensive war machines employed in his time, i.e., in the 4 th century. According to that author the ballista is a sort of great crossbow, whose projectile (javelin) is driven by t the force of several stretched catgut cords. The scorpion, that was called onager in his time, is positively the caable of the middle ages, i.e., a michene composed of a bar with end between twisted cords, like the stick of a saw frame ((bucksaw), and whose head is fitted with a spoon that recei-

receives a ball which this bar throws like a bomb when loosed. Ammianus Marcellinus also designates this machine by the name of "tormentum", hoisted.

Note 4.p.219. Book XXIII. Chap. 4.

Our readers cannot blame us for adding nothing to texts so diffuse and inconclusive as the commentators on Vitruvius and Vegetius and Ammianus Marcellinus, they will prefer to permit us to pass to the study of machines of the middle ages, concerning which we posses data a little less vague.

Machines for attack, from the invasion of the barbarians t till the use of artillery are in great number; some are moved by counterpoises like the trebuchet and mangonels, others by the tension of cords, sinews, branches, springs of wood or of steel, like the caables, malvoisins and stone-throwers, others by their own weight and the strength of men, like montans, battering rams and bossars. Nothing indicates to us that the Romans before the 5 th century employed casting machines with counterpoises, while thew knew and used , as we have just stated, machines with springs, great crossbows turning on one or two feet, as one can assure himself by examining the reliefs of Trajan's column. Casting machines moved by counterpoises are a later invention than machines with springs, because machines with springs are only applied at a larger scale of a hand arm known from all antiquity, the bow. Machines with counterpoises require in their manufacture so many precautions and calculations, such powerful means, that one cannot admit that they were known to the barbarians that invaded Gaul. They must first have imitated the Roman war machines, then have d demanded from the Byzantines the very perfect inventions of the Greeks. Machines previously unknown are mentioned in the annals of S. Bertin, and which were erected before the walls of Angers, occupied in 873 by the Normans, had probably been imposted into France by the artists brought from Byzantium by Charles the Bald. The annalists and poets of those remote times, and even those of a more recent epoch, are hopelessly brief, when they speak of these machines, and they designate them by names taken by chance from the arsenal of war, for t the needs of the measure or rhyme, so that until the time of Charles V, when the chronicles become more precise and clear, there are certain machines to whom is given with difficulty

their proper names. Yet we shall try to discover the use and form of these different machines.

Note 1.p.120. See Cobullus, Bolisto. Duconge. Gloss.

In the song of Roland, one reads:- Old French text). Now f for the walls to be battered or damaged by the caables, it m must be admitted that the caables threw blocks of stone. Hence it was a stone-thrower. "A great stone-thrower called caable, so great --." [1] Guibert of Norgent in his histoire des Crusades,[2] speaks of the numerous ballistas, that were built around the walls of the city of Cesarea by the army of the Christians. These caables anf these ballistas seem to us to be an imitation of the machines with springs in use by the Romans and perfected by the Byzantines. It is certain that these machines had great power, for the same author relates that these machines cast with fury the largest stones, "which not only struck t the external walls, but often carried their shocks to the highest palaces in the interior of the city." These ballistas were placed on wheels and could thus be changed in place according to needs; besides that was a Roman tradition, for on the reliefs of the column of Trajan are seen some of those machines placed on wagons drawn by horses. Many authors have attempted, basing themselves on the painted or sculptured representations of the middle ages, to give an account of t the construction of these casting machines; but these sketched representations seem to be not practical and to resemble the naively conceived sports of children. Yet their effect, although not to be compared to that produced by artillery, occasioned such disorder in the fortifications, that it is indeed necessary to believe in their power, and to attempt to give an accurate idea of them. That is what we devote ourselves to in the following illustrations, and which while respecting t the general information supplied by the vignettes of manuscripts and the reliefs, are studied as if it were necessary to proceed to their construction. It is well understood, that we have adopted only the mechanical procedures known to the mechanical engineers of the middle ages.

Then here is first one of those machines, a ballista, caable or stone-thrower, moved by springs and stretched ropes, adapted to cast stones. (7). The principal timber is the beam A, whose lower end passes through a group of ropes twisted by m

means of the wrench B and toothed wheels C, stopped by clicks. The ropes are passed in two bands attached to the shaft to w which the toothed wheels are fastened, as indicated by the detail D. These cords or sinews twisted at pleasure at the lower end of the beam had a great force of recoil.[3] But to still increase the rapidity of movement to be taken by the beam, springs of wood and sinews wrapped by cords formed two branches E of a bow attached to the cross stop, forcing the beam to s strike violently that cross piece F, when by means of the windlass G this beam had been brought to a horizontal position. When the beam A had been brought as low as possible, a man p pulled the cord H and allowed the escape of the iron rod I, (see detail K), and the beam was quickly brought to the vertical position, stopped by the cross stop F, and then sent afar the projectile placed in the spoon L. The aim was regulated by adding or reducing the pads on the cross piece F, so as to cause the stop to advance or recede, or by attaching leather cushions stuffed with rags to the front surface of the beam. The greater the projection of the stop, the higher would be the aim; the less it was, the more direct the aim. The projectile obeyed the centrifugal force imparted by the rotary movement of the spoon and the horizontal impulse produced by the stop of the cross-piece F. The lower part of the beam presented the section M, so as to prevent its deviation, and it was further kept in its plane by the pulls of the two branches of the spring E. The hooks O served to fix the wheeled frame in place by means of ropes fastened to stakes driven in the ground, and to attach the ropes of teams, when it was necessary to drag it. Four men could pull down the beam by means of the windlass G. So that such a machine should not be rapidly injured by the terrible shock occasioned by the beam striking on the cross stop, it was necessary for this cross piece to be maintained by wooden struts and iron straps, as indicated by our Fig. 7.

Note 1.p.221. William of Tyre. Book VI. Chap. 15.

Note 2.p.221. Book VII.

Note 3.p.221. Everyone knows that joiners stretch saw blades by means of cords thus twisted and held by a wooden stick, t that has exactly the effect of the beam of our machine. (Like a bucksaw).

A general elevation (8) shows the beam lowered by means of the windlass and the beam also striking the cross stop, as well as the start of the projectile from the spoon, the springs being stretched when the beam is down, and set free when it returns to its normal position.

Machines analogous to this also served to drive arroys' but we shall return to that soon in treating of great crossbows with cranks. We shall continue to survey the machines adapted to cast other projectiles like bombs.

Villard of Honnecourt [1] gives us the plan of one of these great stone-throwers with counterpoise so much employed during the wars of the 12 th and 13 th centuries. Although the elevation of this machine is lacking in the manuscript of our Picard architect of the 13 th century, yet the sketch presented by him and the added explanation cast a strong light on this sort of machines. Villard writes at the bottom of his plan t the following note:- (Old French text). [2, 3, 1] The plan given by Villard presents two parallel sills spaced about 8 ft. apart, each being about 34 ft. long. At 14 ft. from the front end of the sills is a cross-piece, which at the scale appears to be 25 ft. long; then four great braces, a S. Andrew's cross between the two longitudinal sills; near the rear end are the two windlasses accompanied by two great horizontal wooden springs. That is an enormous machine, and Villard is right in a advising care to be taken at the moment when the beam is loosed. We present therefore the perspective of this machine, th that our readers may receive a general idea of it. Villard o only gives us the plan of the sills on the ground, but a number of vignettes of manuscripts present us sufficient to complete the Fim. One of the important parts of the description by Villard is the volume of the counterpoise. These boxes are prisms, but portions of cylinders in most old representations; now in giving to this box the form indicated in Fig. 9 of the dimensions stated in the text of Villard, we find the volume of about 706 cu. ft. Assuming for 35.3 cu. ft. of earth a weight of 2646 lbs., we obtain 57,320 lbs. (28.66 tons). "There is a great weight to fall)" To lift such a load required levers of great length' the beam was that lever; it was 26.3 to 39.4 ft. long, composed of two timbers strongly bound together by iron straps and ropes, and receiving between them the iron a

axis made as indicated by detail A. The pivots of that axis entered the two vertical timbers B, reinforced and with iron straps at their ends, maintained in their plane by braces. In case of breakage of the axle a block C received the reinforcement C', to prevent the fall of the beam and all the damages that its fall might cause.

Note 1.p.224.See album of Villard of Honnecourt, pub. by M M Lassus and Alfred Darcel, (Paris. Delion. Edit. 1858), and the English edition,pub by M. Willis (Oxford. Parker).

Note 2.p.224. "If you wish to make a strong engine called trebuchet, pay attention here. Here are the sills as they rest on the ground. Here in front are the two windlasses and the double rope by which the beam is pulled down. Here is how it can be done on that other page. It is a great task to lower it, for this counterpoise is very heavy; it consists of a box filled with earth, 12.8 ft. long, I ft. wide and 12 ft. deep. And to loose the beam (with the pin), think to take care, for it must be kept at that front cross-piece."

Note 3.p.224. M M. Lassus and Darcel have translated "windac" by spring; it is employed in old Picard French for capstan or windlass, as a cylinder around which is coiled a rope. In his translation of Chapter "De balistorum rationibus" (Vitruvius. Book X. Chap. 18), Perrault uses the word "windas" in the sense of windlass and not that of capstan, today one still says "guinde" in the language of the theatre machinist to designate a small rope would on a horizontal cylinder or windlass, from which is "gunidre," which means to the machinist to bear on the windlass, i.e., to turn it in a manner to coil up the rope supporting a burden. Diego Vezzo in the Vraie instruction de l'Artillerie (Frankfort. 1615. p. 122, Fig. 24), gives a jack, that he calls "martinet" in French and "winden" in Flemish; then a crab for raising pieces, that he calls "gunidal". Then "windas" was not a capstan, as M. Willis believes, after the authority of La Hire and Felibien, authorities too recent to have some weight in these matters. M. Willis in the English edition of Villard of Honnecourt with reason removes the error made by the French commentators; but he concludes wrongly, as we think, that the "windas" are little capstans fixed on the front branches of Villard's plan, branches that are evidently springs, and which M. Willis in the engravings added to his

commentory adds connections omitted by Villord; on the controry our outhor tokes core to show thot the two double branches are each of a single piece, and thot they are made of noturol forks. Further, the two horizontol windlosses "windos", mentioned and drawn by Villord, makes the function of the constant useless, and a rope coiled around a capstan could not first pass around a horizontol windlass, for then the capstan could not act, because of the resistance of friction offered by the rope coiled on the windlass. M. Willis must hove assumed pulleys and not windlosses, but the drawing of Villord d does not indicate pulleys, except ot the ends of the springs. The French commentators on Villord of Honnecourt, it seems to us, hove understood the function of the two springs as independent of thot of the two horizontol windlasses; those springs were very useful to force the beam to leave the vertical, at the moment when the men commenced to lower its end; for controry to what M. Willis says, the greatest effort must occur when the pulling rope makes an acute angle with the beam; then the aid of the springs was really useful. Furthermore, our Figs. explain the action of the mechanism. As for the stop on the vertical piece that M. Willis believes to be the proper means to hold the beam when it is lowered, we shall first state that Villord indicates this piece on the horizontal plane, since this piece is too far from the plane of lowering the beam to be able to hold it. This means has nothing practical. this piece would be pulled up; how then could it be kept at the sill? Why would it not be drawn out of the vertical by t the stress of the beam? That bar indicated in the plan of Villard seems to us to be one of the levers of the first windlass, perhaps fitted with a ring at its end for passing a rope, so as to aid the lowering.

Note 1.p.225. MM Lassus and Darcel assume that here is a a question of the spear suitable to be thrown, the trebuchet do does not cast spears, but indeed stones, i.e., projectiles in full flight. M. Merimee has corrected this error and claims that the "fleke" must be taken as the beam of the engine. The opinion of M. Willis seems to us preferable; he claims that the "fleke" must be understood here as a shot; that the word "fleke" refers to the pin that holds the firing cord at the end of the beam, a pin that the master of the engine knocks

out by the stroke of a mallet. The English work click corresponds to the french word "declic". If the word "fleke" is undesstood for a projectile, the text of Villard would not have sense, while our author is perfectly correct in advising the men at the engine to take care at loosing the "fleke", i.e. to stand away, they might be killed by the recoil of the sling at the moment the beam describes its circular arc (Figs. 8, 10, 12). We do not pretend to have completely interpreted t the trebuchet of Villard, but we are compelled to make its working possible; generally when necessary to represent these old war engines, one does not apply to the details the scruples of practicians, required to execute a given programme. Of all these engines represented, we know none that could work; we have thought it would be well once to draw them, as if it were necessary to have them built before us, and to use them ourselves.

Let us see how this machine was worked, whose side elevation is given. (10). When the beam was freed, pulled by the counterpoise C, it took the vertical position A B. To bring it back from the vertical position required a greater pull because of the acute angle formed by the pulling rope with the beam; then one had recourse to the two great wooden springs * traced on Villard's plan and reproduced in our perspective v view (Fig. 9). The ropes attached to the ends of these two springs passed through the grooves of two return pulleys fastened on pins set in the second windlass D.(Fig. 10). In turning that windlass backward, the two cords were stressed as much as the tuo springs permitted. Previously the ring E with its twin pulleys F, through which passed the pulling rope, had been fastened to the staple G by means of the pin H.(See detail X). The pulley I rolled on a slightly bent rope K L so as to make the pull of the windlasses as direct as possible. At the moment when the beam was to be lowered, all being thus p prepared, a server having ascended to attach the double rope to the ring of the draft pulley, the windlasses were turned h backward and held by clicks, the springs tended to resume their position, one or two turns of the windlasses D were made in the direction for lowering, thus aiding the men who began to work on the two windlasses, which required far less force as the beam departed from the vertical. Then were detached the

rings of the cords of the springs, and they continued lowering on the two windlasses a b and a′b′. Eight men (two to a lever for a machine like that represented in Fig. 10), from the instant that the beam left the vertical by means of the springs could bring it to the position A′B′. The loader took the leather pocket and ropes M, placed them in a horizontal straight line at M′, and laid in the projectile; then with a stroke of the mallet, the firer knocked out the pin H. The beam being no longer held, resumed the vertical position by a rapid movement and sent the projectile afar. Here is n t g given, for lack of experience acquired by practice, an exact account of the effect of the combined forces, of the revolution followed by the projectile, and the moment when it must leave its pouch. Some commentators have regarded the pouch of the projectile as an actual sling composed of two cords, one fixed and the other movable, so that by the movement of rotation imparted to the projectile, one of the two cords left i its temporary point of attachment, and the projectile being then left to itself, described in space a more or less elongated parabola. 1

First, many causes might modify the loosening of one cord of the sling; the weight of the projectile, its more or less pull on one of the two cords, a slight obstacle or friction. It might happen to be loosed too soon, and then the projectile would be cast vertically and would fall on the heads of the m men, or it might not be loosed at all, and then be thrown back violently against the beam, and might break it. on consulting the reliefs and vignettes of manuscripts, we do not see represented these two cords of the sling and the temporary attachment of one of them; on the contrary the cords of the sling appear to form only one group of cords or thongs, with a pouch at the end as indicated by our Figs. Further, we frequently see in vignettes of manuscripts a second attachment placed below the attachment of the sling, and which appears to hold that, as shown by the vignette (11) represented in the French and English editions of Villard of Honnecourt. Here the tender holds by his hand that secondary fastening and seems to attach it to the end of the sling. This fastening, sub-cord, that in our Figs.9 and 10 we have sketched at P, assuming it to be d double, and that it could be attached at different points of

the tail of the sling; we are going to see why.

Let (12) be the movement of the beam, when after being brought down, it abruptly assuemes the vertical position by the effect of the counterpoise; the projectile must describe the curve A B C. Now there occurs a moment when the sling will be normal to the circular arc described by the beam, i.e., when that sling will be exactly in the prolongation of the beam, which is the radius of that circular arc. Then the projectile being moved by a considerable centrifugal force, it will tend to escape from its pouch. It is clear that the sling will be more rapidly be brought into the line of prolongation of the beam as that beam is shorter, and that the weight of the projectile is greater. If the sling comes into the prolongation of the line of the beam, when that is at the point d of the arc of the circle, the projectile will not be cast toward the enemy, but on the contrary on those placed behind the machine. There is then a first calculation to be made to give the sling a desired length, so as to throw a weight (?); it reaches the prolongation of the line of the beam when that has nearly reached its highest point. But it is then necessary to determine by an abrupt shock the departure of the projectile, which otherwise would have left the radius while leaving the machine almost vertically. It was to produce this sh shock that was made the sub-cord P. If this sub-cord were attached at P′, for example, so as to form with the beam and t the tail of the sling the triangle P′O R, the tail O P′could no longer leave the angle P′O R, nor move on the point of rotation O. But the projectile C continuing its course forced t the pouch of the sling to obey that impulse until the moment when that pouch indeed reversed itself, the projectile being left to itself and was driven by the centrifugal force and t the impulse given by the abrupt shock of the sub-cord to describe the parabola C′E.

It is indicated by the sketch S, that if the sub-cord P′ we-were attached at P″, i.e., near the fastening of the tail of the sling, forming the triangle P″O′R′ whose angle O′ is less obtuse than the preceding one, the shock would be felt sooner, the part of the sling left free would describe the circular arc C″C‴, or rather a curve C″C″″, because of the principal movement of the beam; the projectile C″″ left to itself with

the double movement of the principal centrifugal force and of the secondary centrifugal force caused by the stop P″, would be thrown in a parabolic line C″″E″ more nearly approaching the horizontal line than inthe the preceding case. In a word, the more the sub-cord is tightened and fixed near the attachment of the sling, the more nearly horizontal is the projectile cast; on the contrary, the looser is this sub-cord and attached near the poumh of the sling, the more nearly vertical will the projectele be thrown. These sub-cords were then a necessary means for regulating the aim and accuracy of flight of t the projectile.

If necessary to regulate the aim, it was also necessary to avoid the destructive effect of the counterpoise, that having reached the extreme limit of its fall must cause a terrible shock to the beam, or break all the connections of the struts. For that purpose, not only was the movement of the counterpoise double, i.e., this counterpoise was attached to two cranks with two pins, but also frequently to the cranks themselves were fixed overhanging weights, as shown in our preceding Figs. Here is what was the effect of these weights T. When t the beam was abruptly under the influence of the box filled with earth or stones, the weights T descending rapidly exerted a force on the cranks at the moment the box reached the extreme limit of its fall, where it was held by the opposed resistance of the beam. The weights not having to directly suffer the resistance continued to fall, inclining the cranks to a line g h, and thus partly destroyed the shock imparted by the abrupt tension of these cranks. The weights T decomposed to a certain point the vertical pull produced by the box, and neutralized the shock that would have broken all the pivots, nowise changing the rapid movement of the beam, by substituting friction on the pivots for a shock produced by an a abrupt tension.

These machines with counterpoises were in use up to the moment when cannon came to replace all the casting machines of the middle ages. The learned bibliophile M. Pichon possesses an account of what was paid for the transportation of one of these machines in 1378, that served at the siege of Cherbourg. Here is that curious document, that its possessor has courteously communicated to us:- "The master Thomin, citizen of Pon-

Pontorson, governor of the machine, of the said city, the master carpenter and 5 other carpenters, 10 masons and laborers, 40 tenders, 31 wagons, including the wagon that carried the beam of the said machine; for three wagoners ordered to serve that machine at the siege of Cherbourg, came to Carentan, and we, Endouin Channeron, doctor in the domain, the bailiff of Costentin, and John of Iles, bailiff there for the king our sire in lands that belonged to the king of Navarre, clerk and deputy in those parts, on account of our lords the generals sent by the king our sire for the said siege; the 15 th day of November, in the year 1378:- and first:-

The said Thomin, the present master of the said machine, and expenses for 10 days, total-- ?.

Michel Rouffe, master carpenter of the said machine, 10 days. etc." ?

Then follows the account of the carpenters, masons, laborers, wagons and horses. This memorandum shows the importance of these machines, that required such a numerous body to place and work them. The number of 40 tenders sufficiently indicates the power of these engines, for assuming that they were divided in two shifts (their labor being very fatiguing, since they were charged with working the windlasses, they 20 tenders were required to pull down the beam of the trebuchet. The masons were probably employed to level the areas on which the machine was placed.[1] Pierre of Vaux-Cernay, in his Histoire des Albigeois, speaks of numerous mangonels erected by the army of crusaders before the castle of Termes, that cast against that place enormous stones, so that these projectiles made s several breaches. At the siege of the castle of Minerve (in Minervois), says the same author, "There was on the part of the Gascons one of the machines called mangonels, in which they labored night and day with much ardor. Likewise at the south and north were erected two machines, i.e., one at each side, finally on the side of the count, i.e., at the east, w was an excellent stone-thrower, that daily cost 21 livres for payment of the men employed there." At the siege of Castelnaudry undertaken against Simon de Montfort, the count of Toulouse caused the preparation of a machine of enormous size to destroy the walls of the castle, that cast enormous stones, and overthrew all that it struck. One day the count (Simon de

Montfort) advanced to destroy the said machine; and as the e enemy had surrounded it by ditches and barriers, so that our men could not reach it." Indeed care was always taken to enclose these machines by barriers and wattles, both to prevent the enemy from destroying them and to protect the men that worked them. At the siege of Toulouse, Pierre of Vaux-Cernay relates, that in the combat where Simon de Montfort was slain, "the count and the few men that were with him retired because of a storm of stones and an insupportable cloud of arrows, t that overwhelmed them, stopped before the machines and behind hurdles to shelter themselves, for the enemy cast on our men an enormous quantity of stones by means of two trebuchets, a mangonel and several machines." Then Simon de Montfort was struck by a stone cast by a stone-thrower worked by the women on Place S. Sernin, i.e., at least 640 ft. from the place that the combat occurred. Sometimes the early authors, as in this passage, seem to distinguish the trebuchets from the mangonels. The mangonels certainly were machines with counterpoises like the trebuchets, but the mangonels had a fixed load placed at the end of the beam instead of a movable one, that gave them a particular property.

Note 1.p.232. The importance of the construction of these machines may also be proved by consulting the old accounts o and inventories of fortresses. When in 1428 was destroyed the machine placed on the tower of S. Paul at Orleans, to replace it by cannon, the carpentry of that war machine, that was either a trebuchet or a mangonel, filled 26 wagons, that were driven to the chamber of the city. (Jollois, Histoire du siege d'Orleans. Chap. 1. Paris. 1833.

Villard of Honnecourt calls the machine with counterpoise s suspended by cranks, the counterpoise in the form of a box, a trebuchet; from which one may conclude that if the mangonel is also a machine with counterpoise, this can be only the pendulum machine, such as reproduced in the relief of S. Vicaise of Carcassonne,[1] and in many vignettes of manuscripts.[2]

Note 1.p.233. A relief supposed to represent the death of Simon de Montfort, and which is deposited in chapel S. Laurent of the church S. Nazaire of the city of Carcassonne.

Note 2.p.233. Latin and old French note.

We have seen that the sling of the trebuchet has its two c

cords attached to the head of the beam, and that the projectile leaves the pouch of this sling from the effect of the shock produced by the sub-cord. In the representations of machines with beam and balance, one of the cords of the sling is fixed at the end of the beam, and the other is simply passed over a pin, so that when the beam reaches its highest point, this c cord ol the sling leaves its pin, and the projectile is cast like the ball from a hand sling. This machine, as we shall soon state, possessed properties different from the trebuchet. The trebuchet by its abrupt movement or jerk was good for throwing projectiles over high walls or on roofs, just as our m mortars throw bombs, but it could not cause the projectile to describe a very elongated parabola approaching the horizontal line. The aim of the mangonel could be regulated much better than that of the trebuchet, because it described a greater circular arc, and it was possible to accelerate its movement.

We shall endeavor to explain this machine.

First (Fig. 13) the beam, instead of passing in the axis of the pivots, was fixed outside this, as indicated by the sketch at A. At its lower end, that was much enlarged (we shall see now and why), were attached weights, ingots of iron or of lead or stones, held by straps and a box of planks B. In its normal position, the beam instead of being vertical as in the trebuchet, must necessarily be inclined toward the enemy, i.e., toward the front of the machine,[1] because of the position of the counterpoise and that of the axle. To lower the beam two wheels C were used, fixed to the windlass and corresponding to two guide pulleys D. It is clear that before the enemy, it was not possible to have a man ascend to the top of the beam to fix there the double pulling rope with its pulley and its hook, first because that cord and pulley must be quite heavy, then because a man so exposed to hostile eyes would have served as an aim for all archers and crossbow men. We have just seen that these machines were surrounded by barriers and hurdles intended to protect the members that remained on the ground. By means of a little windlass E attached to the surface of the box of the counterpoise, and moved by two cranks, by the aid of the double rope F passing through two strong pullies G, the pulley H and its hook, to which had previously been attached the pulley K. The beam being lowered to the inclinat-

inclination M, the hook of the pulley K was loosed, and the beam described the circular arc M N. The tenders accelerated this movement by pulling on several ropes attached at O and taking the direction O R. If when the beam was loosed the m men pulled strongly on the ropes, and all together, they made the upper end of the beam describe a much greater arc than t that produced by the sole action of the counterpoise, and thus they increased the impulsive force of the projectile S at the moment of its departure. To attach again the pulley K to the pulley H, it was drawn down by means of a rope P and backing the windlass E. The working was sufficiently rapid to make it possible to send 12 projectiles in an hour.

Note 1.p.234. In this elevation we assume one of the side supports to be removed to show the connection of the axle w with the beam.

To facilitate lowering the beam, when the men turned the two great wheels C, the men placed to handle the cords of the counterpoise B pulled on ropes attached at O in the line O V. When the beam was lowered, the men charged with attaching the sling laid the two cords of that sling in the hollow T. One o of these cords remained fixed to the ring X, the other being left likewise on the pin U, the tenders took care to replace the ring of this second cord on the pin, and evidently allowed these two cords to pass above the double cord for pulling the beam, as indicated by the section Z, the two pulleys at a, the end of the beam lowered with its pulley H at h' its pulley K at k, the two pulleys d at d, the two cords of the sling at g g. When the firing cord acted on the little arm e of the hook, the pulley K fell between the two sills, the beam rose and the two cords drew the projectile S. It will be observed here that the projectile S being placed in the pouch of the sling, the two cords of that sling being of equal length, the one attached to the ring X is loose, while the other fixed to the pin is stretched. The utility of this arrangement will be demonstrated at once. One should again examine the position of the counterpoise, when the beam is lowered; that position is such that the beam must be in equilibrium; that consequently the effort of the tenders to bring it down should be almost nothing, which allows pulling the rope on the pulley K, as indicated by the sketch Z; that this equilibrium obtained by the

principal loads on the axle A, makes effecient the pulling of the men placed at the counterpoise, since at the moment of f firing, there must be a sort of indecision in the movement of the beam; that this pull adds a powerful aid to the weight of the counterpoise, which is necessary for the sling to act properly.

Fig. 14. represents the mangonel from its front side, at t the moment when the beam is lowered. The six men working in the two great windlasses remain within the wheels, so as to unwind the double ropes when the beam has shot the projectile placed in the pouch of the sling. Sixteen men are ready to p pull on the four cords attached to the lower part of the counterpoise. The firer is at his post at A, ready to loose the hook that retains the end of the lowered beam. The master of the machine is at B, he is going to give the signal that causes the simultaneous action of the firer and the pullers' at his call, the beam being no longer held and being pulled by 16 men placed in front, it will rise abruptly and pull the sling, that whistling will describe the great curve and cast the projectile.

Let us now examine how the sling must be attached by only one of its ropes in order to leave at the proper time the pin of the machine, so as to leave the projectile liberty to escape from its pouch.

Here (15) is the end of the beam; one sees at A the fixed attachment consisting of a long clevis swinging on a bolt B; then at C is the iron pin enlarged at its base, and at D is the loop that only slips ower the pin to a certain point, that it cannot pass on account of this enlargement. When the ring is pulled by one of the ropes of the sling (see sketch G), its ring E must fall on the circumference described by the ring F of the loop, a circumference of which the beam is evidently the radius, it is also necessary for the loop to not pass the line I E and be stopped at K by the width of the end of the beam. While the rope of the sling attached to the ring E of the clevis has not passed the line E E′ by the movement imparted, the prolongation of the line I E, the other rope of the sling pulls obliquely on the loop, so that this loop cannot leave the pin C.

That being understood, Fig. 16 indicates the rotary movement

of the beam. The movable rope of the sling will not leave the pin until the projectile has passed the radius of the circle described by the beam, only at the moment when the ropes of the sling form an angle with the beam, as traced in the position A. Then one of the ropes of the sling will continue to pull on the clevis, while the other will loosen, and the centrifugal force impressed on the projectile will cause the loop to leave the pin, as we see at M. The free projectile will d describe its parabola. If the movement of rotation of the beam were equal or progressively accelerated, there would occur a moment when the projectile would be found in the prolongation of the line of the beam (radius), t not leave the line till the moment when the beam stops. But this is not the case, thanks to the arrangement of the axle outside the line of the beam, and the location of the counterpoise outside the axis and the pulling of the men to quicken the movement of rotation at the moment of loosing, a very violent impulse is at first given to the beam, and consequently to the projectile, t the latter under the influence of that primary force describes its curve more rapidly than the beam describes its given arc, since this becomes slower as it approaches its highest point; therefore the cords of the sling must make an angle with the beam as seen at M.

The men placed at the base of the counterpoise regulated t the aim by pulling more or less on the ropes there. If they pulled strongly, the beam described its arc more rapidly and the centrifugal force of the projectile was greater; it sooner passed the prolinged line of the beam; the movable cord of the sling was sooner detached, and the projectile rose higher, b but passed over less distance on the ground. On the contrary, if the men at the counterpoise pulled less on the ropes or n not at all, the projectile was slower in passing the prolongation of the line of the beam; the movable cord of the sling was loosed later, and the projectile only left its pouch when this had passed the vertical, did not rises as high, but passed over a greater distance. Thus the merit of a good master engineer was first, to give the cords of the sling the proper length according to the weight of the projectile, then to regulate the attachment of these two cords, and finally to order more or less pulling on the ropes, according to whether he d

desired to send his projectile higher or farther.

There was then a notable difference between the trebuchet a and the mangonel. The trebuchet was a machine much less easily managed than the mangonel, but it required less practice, since to regulate the aim it sufficed for a man to know how to attach the sub-cord of the sling. The mangonel must be directed by a skilful engineer, and served by men experienced in the work, unless it would be dangerous for those using it. Indeed, there is sometimes mention of mangonels that would kill their men, a false act, an improper pull on the ropes of the counterpoise, and when it had already made a part of its revolution, it might loose the cord of the sling too late and cast the stone on the men placed at the front of the machine.

It would be superfluous to lay more stress on the mechanism of these machines with counterpoises, we have only claimed h here to give to this study a more practical turn than in the past. It is clear that to know exactly the effects of these formidable war machines, it would be necessary to make them at a large scale and put them to the proof, which would be useless today in view of rifled cannon, we have thought that it was well to make known what our afthers brought to the art of killing men , and the subtlety of the care that they devoted to their building of palaces or churches. These batteries of machenes with counterpoises, that constantly by night and by day threw projectiles into camps or hostile cities, causing such terrible damages, that it was necessary to come to surrender, were not then the toys usually shown as in works on the military art of the middle ages. The projectiles were of various kinds; balls of stone, bundces of pebbles, a mass of carrion, burning materials, etc.[1]

Note 1.p.240. See Precis hostorique de l'influence des armes a feu sur l'art de la guerre, by prince Louis-Napoleon Bonaparte, president of the republic. The illustrious author p proves the importance of the great casting machines of the middle ages, and recognizes their value.

The orientals appear to have been the first inventors of t these machines with counterpoises, using them with advantage already in the 11 th century. They also employed stone-throwers, Turkish stone-throwers, by means of which they cast on the hostile works not only stones, but also barrels filled w

with inflammable materials (Greek fire), that water could not extinguish, and that adhered while burning to the wooden defensive galleries or planks.

Joinville has left us a streking description of the terreble effects of these machines. "The king and council," says he, " "when it was necessary to pass the branch of the Nile before the Saracens, had a road built across the river to pass toward the Saracens. To protect those working on the road, the king caused to be built two towers, that are called shooting castles (we shall soon treat these machines); for he had two towers before the army and two palisades there to cover those t that watched the shots of the machines of the Saracens, who had 16 machines, 3 all (on the same line and in battery). When we came there, the king had 8 machines made, of which Jocelin of Cornaut was master engireer (a master engineer then d directed the working of several machines). Our machines injured theirs, and theirs ours; but in which I did not hear that ours did much. One evening earlier, when we watched the towers at night, that they had a machine called stone-thrower, that they had also made, and placed Greek fire in the spoon of the machine. The first cast that they made came between our two towers, and struck the place before us that the army had built to pass the river. Our firemen (there were then men particularly charged to extinguish the fires kindled by the enemy) were called to put out the fire; and because the Saracens c could not fire on these firemen on account of the palisaded works connecting the two towers, that the king had caused to be built, they shot straight to the clouds, so that the darts might fall vertically on them. The manner of the Greex fire was such, that it came forward as great as a barrel of verjuice, and the tail of fire from it was as great as a large sword; it made such noise in coming and damage in falling, that it seemed that it was lightning from the sky; it appeared like a dragon flying through the air, such great light was made, that one could see among the army as if it were day, for the great massof fire cast a great light."

These barrels filled with inflammable materials appear to h have been thrown by stone-throwers like that represented in Figs. 7, 8; they had a fuse and contained a mixture of sulphur, oil of naptha, camphor, bitumen or resin, charcoal, dust,

salpetre and perhaps antimony. At that epoch in the middle of the 13 th century, according to Joinville it seems that our casting machines were inferior to those of the Turks, since our always sincere author takes care to state that our machines produced no great effect. Indeed it was only at the end of the 13 th century, that the machines appear to have attained great perfection in France. They were much employed in the wars of the 14 th century and even after the invention of artillery.

The trebuchets and mangonels were placed by the besieged b behind the curtains and on the ground, and they sent their p projectiles against the enemy by passing over the heads of t the crossbow men placed in the galleries. But besides the stone-throwers placed in battery at the level of the galleries on wooden platforms extending these galleries (as we have shown in Art. Architectsre Militaire, Fig. 32), the armies of the middle ages also possessed the tower crossbow, which was a machine, with which were thrown darts of great length, iron bars heated red hot in a fire, arrows wound with tow and Greek fire [1] in the form of rockets. These tower crossbows had the advantage, that they could be aimed like our artillery, which could not be done with the mangonels and trebuchets, as for the latter machines, if it were possible to regulate the aim, this could only be in the same plane, if one desired to cause the projectile to deviate to right or left, it was necessary to move the entire machine, which required a long time. Thus the mangonels and trebuchets were only employed in sieges, either by besiegers to send projectiles against a point of the defenses of the city, or by the besieged to batter the works of approach or the quarters of the enemy. The tower crossbows fired on groups of laborers, on the machines, on serried columns, and they produced the effect of our field-pieces at short range, for their projectiles slew entire files of s soldiers, broke the machines, cut their ropes and passed through the mantlets and palisades.

Note 1.p.244. "We received the Greek fire three times that evening, and they fired the tower crossbow four times." (Joinville. Hist. de S. Louis). "The brothers of the king watched at the tops of the towers (i.e., were on duty at the summits of the towers) to draw from the Saracens the crossbow bolts,

that were cast among the host from the Saracens.

Here (17) is a perspective of the tower crossbow and its details. It is moved by means of three wheels, two of which were fastened to the lower cross-bar A and the third to the movable portion of the carriage. A post C set on an ovoid pin is indicated by the detail C′, holds the carriage on a fixed point serving as a pivot. It was then easy to regulate the fire in the horizontal plane. To raise or lower the aim, i.e., to aim higher or lower, one could first remove the end wheel E, allow the carriage to rest on the two oval rollers F and then the aim would take the direction F′G (See outline X). If it were desired to lower the fire a little, the upper part H of the carriage was raised by the double rack K and the two pinions I, to which were attached two cranks. If it was necessary to lower the fire, the wheel E was left in place, and the upper part of the carriage was raised by means of the racks. The lower part of the carriage was moved on the axle L. The motor consisted of two double steel springs passed through twisted ropes of sinews, seen in our perspective sketches, their ends resting against the two vertical posts of the frame. To stretch these sinew ropes as much as necessary, iron pipes were passed through them, levers were insested in these tubes, at either end, to not allow the ropes to untwist, and the ends of these levers were fastened in the two projections V. If it was felt, that the ropes stretched, these levers were moved a little, refastening them so that the two branches of the bow were always held equally. To bend the bow whose ends were connected by a cord made of hair, sinews or catgut, the two hooks N were placed on that cord; then working the two great cranks O, the cord of the bow was brought by means of the two horizontal racks as far as the double catch P, which to pas the cord was lowered as indicated by the detail R. This trigger was moved by the rod S with its movable ring T at its end, that was passed over a pin, when the catch was raised. Then backing slightly on the racks, the cord stopped on that double catch U, that could not drop into the carriage. The end of the projectile was placed against the end and left free in the groove. And the pointer having arranged everything removed the ring T from the holding pin, and pulled the rod S toward him; the double catch disappeared and the cord returned to its normal

place while projecting the dart. (See plan Y). A slight pressure on the dart by a spring prevented it from slipping in its groove if the fire were quite plunging. With a machine of the dimensions given in our Fig. could be shot with full force a spear more than 16 ft. long, a real beam armed with iron, to a great distance, i.e., at least to 164 ft., so as to break machines, palisades, etc. These machines then throwing projectiles directly were those causing the most disorder in troops and particularly in cavalry; thus they were not only used in sieges, but also in the country, at least to protect camps, or to strengthen an important post.

There was also employed a machine with a spring, whose force was less, but more simply constructed, and it could be made in the country with the wood that could be procured, without its being necessary to use racks and all that ironwork, which required time and special workmen to make them. This machine is very ancient and recalls the catapult of the Romans of antiquity. It consists (18) of a vertical cylindrical axis with a flat front (see plan A) turning on two pins. At the base of this axis is fixed a triangular frame placed on two wheels and connected with the said axis by two ties or struts. Wooden s springs are strongly fastened to the foot of the axis with i iron straps and sinew cords. A windlass fixed on two verticals is moved by cranks and pinions. One end of a cord is fastened to the upper end of that spring, and another end with hook wi- with projecting arm B is coiled on the windlass after having passed over a directing pulley. Four men bent the spring. A s spear passed through a hole made in the upper end of the axis D, and a movable forked support E supported by the rack F, p permitted raising or lowering the fire, as shown by the sketch G. When the spring was bent, the pointer placed the spear, moved the lower frame on its bed according to the direction o of the fire, and pulling the cord C loosed the hook; the spring struck the spear at its end and sent it far in the direction given to it. Fig. 19 gives the plan of the machine.

Artillery was employed when yet for a long time were used these machines with counterpoises for battering, and these t tower crossbows, man trusted so much to their power. even if the first cannons did not attempt to produce other effects. The stone-throwers, trebuchets and mangonels threw in full f

flight great balls of stone, that weighed up to 200 or 300 lbs,; these could not cast projectiles with full scope. They were replaced by mortars with which the same results were obtained; and these guns sending balls point blank, after the 14 th century were only small pieces throwing projectiles of the size of a grapeshot.

ENGINS OFFENSIFS A FEU. Offensive Artillery.

From the day when was recognized the force of the gases produced instantaneously by gunpowder, men had the idea of utilizing that force to send afar solid projectiles, balls of stone or cases of pebbles. A great advantage was found in replacing the enormous and expensive machines, some examples of which we have just described, by iron tubes more easily transported, costing less to establish, and that the enemy could scarcely injure. We have nowhere seen that the military nobility occupied itself in perfecting war machines or in directing their construction. All names of engineers are names of plebeians. If Philip August, Richard Lionheart and some other warlike s sovereigns appear to have attained importance in the manufacture of the machines, they always had recourse to master engineers, that seem to have sprung from the people. This disdain of combinations requiring mathematical labor and the knowledge of several trades, such as carpentry, ironwork and mechanics, the nobility at first applied to the primary study of artillery: it did not seem to take account of this formidable application of explosive powder, and left to tradesmen the care of seeking the first elements of the art of the artillerist.

In 1356 the Black Prince besieged the castle of Romorantin; among other casting machines, he employed cannon for throwing stones, bricks, buckets filled with Greek fire. Those first guns were long, thin, made of iron staves, of cast iron or c copper, reinforced at certain distances by iron rings, and t transported on the backs of mules or on wagons. Those guns w were then called "acqueraux, sarres or spiroles", and later "veuglaires,", and consisted of a tube open at each end, to one end was fitted a case containing the charge of powder and the projectile, i.e. the gun was loaded at the breech; but t this breech was completely independent of the tube and was fastened to it by a movable band, as indicated in Fig. 20. At

At A is seen the case of the gun cut lengthwise, at B is the cross section at a b; at C is the case joined to the piece by means of the band, that stops on the projections d d′ of the serrate ring; at D is the same case shown laterally with the band e fitted with its handle for lifting it and removing the case when the piece has been fired. The top points g on each of the serrate rings served for aiming. We do not know much of how these guns were pointed; they were probably suspended from trestles by the rings with which they were furnished. T The movable cases fitted to one end of the tube allowed the escape of a considerable part of the gas, and this must frequently cause accidents, hence were renounced the fitted cases, to make guns cast in a single piece, loaded at the muzzle. S Some years since were found in the church of Ruffec two guns, that appeared to belong to the 14 th century; these are tubes of cast iron without cases, closed at the breech and suspended by rings.

We give (21) these two pieces, which are of small dimensions; at A we have sketched a fragment of a cannon, that seems to us to belong to the same epoch, which was found in excavations at Boulogne-sur-Mer.

In 1380 the Venetians employed cannon in the war against t the Genoese; "ribaudequins." (Small guns on wheels).

Those first pieces of artillery were replaced by mortars a and cannon.

After 1412 the use of mortars and guns caused the disappearance of offensive machines for the defense of places. "It results," says Jollois in his Histoire du siege d'Orleans (1428) "from a statement made with care by the late abbe Dubois, that in 1428 and 1429 the city of Orleans possessed 71 cannon, both guns and mortars, all of copper. In the number of these p pieces are comprised the gun lent to the city of Orleans by the city of Montargis, a great cannon named Riffard,[1] a mortar made by one named William Duisy, a very skilful workman, according to the journal of the siege, that threw stone balls weighing 120 lbs., and so enormous that it required 22 horses[2] to haul it with its carriage from the harbor to the city hall. These two cannon and this enormous mortar were placed in battery on the tower of the cross of Meuffray, located between t the bridge and the postern Chesneau, from which the battered the fort of Tournelles in the possession of the English.

Among the guns just indicated must be counted a cannon [3] that threw stone balls as far as the island of Charlemagne. It was only under the reign of Louis XI that iron balls were substituted for stone balls." Yet the latter were still used at the end of the 15 th century.

Note 1.p.249. See Journal of the siege, p.21. It was customary to give names to the machines during the middle ages, just as in our days to portholes in the marine. Until the 16 th c century each gun had its name, perhaps they had sponsors like bells.

Note 2.p.249. This fact is the result of the expense included in the accounts of the fortresses for payment of this transportation.

Note 3.p.249. "One sees in the accounts of the fortresses of the city of Orleans, that a skilful artizan named Naudin=Bouchart cast during the siege a very beautiful and very long gun for throwing balls from above the bridge into the island of Charlemagne, against the English who crossed the Loire to pass from this island to the field of S. Pryve, where they h had a fortress." From the old bridge to the middle of the island of Charlemagne is 3810 ft.; mortars and cannon then could not carry to such a great distance, the cannon of Naudin-Bouchart was an innovation.

Although the names of cannon and mortars may have been given indifferently to guns that threw stone balls, yet the name of mortar appears to have been given by preference to a short gun of very great diameter, throwing projectiles with full flight' while the cannon of less diameter and longer could send balls point blank.

These mortars are sometimes designated by the name of basilisks. At the siege of Constantinople in 1413, Mahomet II placed in battery mortars with stone balls of 200 lbs. These g guns were cast by a Hungarian. One of these mortars was even intended to throw a ball of 850 lbs.; 2000 men must serve it, and 10 pairs of oxen haul it, but it burst at the first test and killed a great number of men. In 1460 James II of Scotland had a monster mortar cast, that exploded at the first shot.

About that epoch were renounced hooped guns, but cannon and mortars were made with inserted cases, principally for pieces of not very great diameter; since for mortars that threw balls

of 60 lbs. or more, they were made of cast iron or copper, or even of wrought iron in the form of a tube with a single opening. There exist some mortars made in the middle ages of flat iron staves encircled by iron hoops like casks; perhaps these guns are the oldest; they were not loaded by means of powder cases, but like our modern guns, except that the powder was introduced by means of a spoon, then the wad and the ball, lastly a wad of hay or rags, by the aid of the rammer.

The first cannon known to us and so fabricated is found in the arsenal of Basle (Switzerland; 22). It is of wrought iron. The breech A is forged in a single piece; the body consists of staves of flat iron 1.18 ins. thick by 2.36 ins. wide. These staves are united by a series of iron rings of greater or lesses thickness, at B is a much thicker ring beneath which is placed a band of copper. At C is represented the mouth of the gun, whose bore is not less than 13.0 ins. diameter. The touchhole is very small. In the same arsenal is seen another gun of copper 6.6 ft. long; it dates from 1444 and bears the shield with the arms of Burgundy. During the 15 th century w were made guns of very variable dimensions, from the falconet that carried a ball of one lb. to the mortar that threw stone projectiles of 200 lbs. or more.[1] These mortars were seldom long in proportion to their diameter and fulfilled nearly the function of mortars sending the projectile in full flight; th- they were loaded at the muzzle. Hollow projectiles were also employed, that were filled with explosive materials or Greek fire, and it is an error to suppose that bombs are the invention of the last years of the 16 th century, for several treatises of the end of the 15 th and beginning of the 16 th centuries show actual bombs made of two hemispheres of wrought i iron connected by cords or bands (23). At the end of the 15 th century, cannon are classified by nature, according to the diameter of the projectiles; there are basilisks, which are the largest, mortars, ribaudequins, cannons, flying dragons, scorpions, culverines, stone-throwers, sirens, "passe-mur," "passe-avant," serpentines. Under Charles VII the royal army already possessed numerous artillery, and Charles VIII in 1494 entered Italy, taking more than 140 bronze cannon, mounted on wheeled carriages, drawn by teams of horses, and well served.[3] The Italians then possessed only iron guns hauled by

oxen, so badly served that they could scarcely fire one shot in an hour.

Note 1.p.251. There still exist in many old cities, and notably at Amiens, stone balls, "bedaines," that have up to 23.6 ins. diameter, and which weigh up to 276 lbs.and more. These balls are perfectly spherical, cut with care in hard sandstone.

Note 2.p.251. See RobIt Volthurius, De re militari, pl. of 1483, Paris edition, 1535. p. 116. Paris. printed by Christian Wechel.

Note 3.p.251. Guichardin, Commines, Paul Jove.

The idea of loading cannons at the breech was that first p presented, as this will probably be the last improvement made in the fabrication of cannon. Men must reject the first cases that fitted badly, allowed the gas to escape, sometimes sent a large portion of the load at the men, and were quickly put out of order by the effect of the recoil. Men contented themselves with making at the breech of the gun a recess allowing the introduction of an iron or copper case containing the charge of powder kept in place by a disk of wood. This case was fixed in several ways; it was fitted with a handle to aid in placing it and removing it after firing. The ball was slipped into the bore of the gun before introducing the case, and was rammed down with a wad of hay or turf after this introduction. Each cannon had several cases loaded with powder beforehand, so as not to delay firing.[1] Each case was pierced by a touchhole that was fitted with a tube filled with powder, that the firer inflamed by means of an iron rod heated redhot in a furnace. This method had some advantages: it avoided heating the gun and the accidents resulting therefrom; it permitted the preparation of the loads in advance, for these cases were merely cartridges inserted in the breech, like the cartridges of Lefaucheux guns, except that the ball must be inserted before the case and be rammed down afterwards. It had inconveniences, that are easily recognized, a considerable part of the gas must escape at the junction of the case with the bore, and consequently the force of the explosion was partly lost; it was necessary to clean frequently the bottom of the chamber and the groove to remove the dirt, that opposed the perfect junction of the case and of the gun; the point of junction was worn after a certain number of shots, and then nearly the

entire charge escaped without action on the ball.

Note 1.p.252. The name of case given to bombs fired at festivals comes from this. Then at public rejoicings instead of loading pieces of artillery, as at present, with blank cartridges, men were contented to load the cases of cannon, tamping the powder with wooden tamps driven by strokes of a mallet. At the beginning of the (19 th) century were still found in most old cities old cases reserved for this use.

We give (24) drawings of these cannon with inserted cases. At A is a gun with jaws for th insertion, the transverse section through the case is indicated at B; the case C with its handle D and touchhole E is in its intended place; two keys G pass through two holes in the jaws and press the case against the bottom of the opening. At H we give the longitudinal section of the case ready for firing; by means of the key K, the opening of the case has been forced into the groove I made at the entrance of the bore; the two horizontal keys G have been driven by strokes of a mallet; the case is full of powder held by the plug T; the ball is rammed down. At V is seen the empty case with its plug and tube O for the touchhole. At P we have represented another system of insertion without jaws, i into which the case was also forced into the groove by a key, and it was held by means of a single longitudinal bar hinged on the bolt N; a single key R passing through the two ends of a band of wrought iron, held that longitudinal bar.

In the last case the touchhole of the case was at one side.

It is necessary to believe that the inconveniences inherent in this system caused it to be abandoned very quickly, for t the use of these guns with inserted cases was soon rejected to further employ only tubes of cast iron or copper with a single opening. Besides if one saved time by loading several cases in advance, they lost much in removing the keys and replacing them, without counting that the holes for the keys a quickly became worn, were enlarged, and no longer allowed the cases to be properly held,and it was then necessary to change the keys and to use thicker ones. Some of these guns are still seen in our arsenals and at the museum of artillery at Paris; some are of wrought iron, but the largest are of cast iron.

The first cannon were mounted on carriages without wheels, and simply set on wood, or carpentered as then said, i.e., pl

placed in a trough made of great timbers and fastened together by bolts, iron bands or merely ropes. The pointing was only obtained by raising this wooden trough at front or rear by m means of crowbars and wooden wedges (25). They said mount a mortar to point it. Du Clercq in relating the death of Jacques de Lalain, says that "the marshal of Burgundy, lord Antoine, bastard of Burgundy, lord Jacques de Lallaing, (at the siege of the castle of Foucques) went to mount a mortar to batter the said castle; and as they seated the said mortar, those of the castle fired a little cannon at the said lords, with which gun they hit J. de Lallaing and carried off the helmet from his head." From affuter (to mount) comes the word affut (carriage, that from the 16 th century was employed to designate the carpentry supporting the cannon, permitting it to be placed in battery and pointed.

The vignettes of manuscripts of the middle of the 15 th century give us a great variety of these primitive troughs.[1] Under Charles VII and Louis XI however, the field artillery made rapid progress; already at that epoch men possessed carriages arranged for firing, allowing the guns to be pointed quite rapidly; but they were far from having conceived the portable advanced train, and when cannon were transported, it was necessary to place them on special wagons separate from the carriages. During a battle the artillery could not be moved, except some small cannon, as done 250 years since. The artillerists mistrusted their guns so much (and certainly with good reason), that they sought to ensure themselves against the v very frequent accidents that occurred in firing. Not satisfied by enclosing the cannon in heavy carpentry, and hooping them strongly to prevent their bursting on to lessen its effect, they often fixed their cannon and mortars in boxes composed o of heavy timbers strongly bound together. These troughs formed a guard around the piece, which protected the men in case of accident. At the moment of firing everyone stooped, and the man charged with firing by the aid of a long rod made red at the end, placed himself beside the trough.

Note 1.p.254. Art. Architecture Militaire, Figs 42 to 43 bis.

Here is one of those trough carriages (26). The gun was inclined so as to throw the projectile in full flight; its muzzle was enclosed in the fronm end of the trough and its bree-

breech rested on the bottom. At A is seen the cross section of the piece and its trough, and the arrangement of the ropes that fixed it. The recoil of the gun was prevented by stakes B driven in the ground. At C is placed the furnace for heating the rods for firing. The charge of powder was inserted by means of a great wrought iron spoon. One imagines that such an engine could be moved but mounted but once, i.e., placed in position to send projectiles to one point, thus these guns were employed only in sieges and not used in the field. If t the artillerists claimed to protect themselves from the explosion of a defective gun, they also thought of sheltering themselves from the hostile projectiles. For that purpose thick mantlets of wood were placed before the cannon. These mantlets swung on a horizontal axis, were raised at the moment of firing, and became vertical by their own weight when the piece was discharged, so as to thus shelter entirely the men occupied in loading it. (27).[1] Then were also made triangular carriages, more easily handled than the preceding, allowing the pointing within a certain arc of a circle. These triangular carriages were fixed at the apex of the triangle by means of a pivot, and were swung by the aid of two wheels fixed at the ends of the cross-piece. But men renounced those mortars of e enormous dimensions only suitable for throwing stone balls. iron balls were adopted, considerably less powder was burned, and the cannon no longer attained those colossal proportions, that rendered transportation difficult.

Note 1.p.256. At the siege of the castle of Poucques in 1453, when Jacques de Lalain was killed, he and other lords "went to see the artillery and a mortar named the Bergere (shepherdess), that fired frequently; and they kept themselves covered by the mantlet of that mortar." Mem. d'Olivier de la Marche, Chap. 27. "And they (men of Ghent) had banners, wagons, mantlets, culverins and artillery (battle of Berselle)." Chron. de J. D. Lalain. "And they (men of Ghent) went right before the city of Hulst, taking a great number of wagons, artillery, b both cannon, culverins, mantlets and other things, belonging to the said artillery. (Siege of Hulst)." The same.

At the end of the 15 th century and the beginning of the 16 th were cast bronze guns of remarkable dimensions and beauty. There exists in the arsenal at Basle one of those great guns

14.8 ft. long, covered by ornaments and ending in a dragon's head; it was cast at Strasburg in 1514.

Fleurange in his Memoirs, chapter VII, says that in 1509 t the Venetians, at the battle of Aignadel by the French, possessed "60 good pieces, among which were some longer than long culverins, which are called basilisks, and fired balls, all h had a lion on top, or had inscribed around the said lion "Marco."

At that epoch were already employed mortars suited to the great stone balls or cases filled with inflammable materials. A painting by Feselen (Melchior), deceased in 1538, and now forming a part of the collection deposited in the Pinacothek of Munich (No. 35), representing the siege of Alesia by Julius Cesar, shows us a great mortar mounted on a carriage, in which the artillerist places a spherical projectile (28). The two wheels are taken off and lie beside the carriage. Thus t the mortar seems to rest on the ground, and the proper inclination was given to it by the aid of levers and wedges slipped under the breech. At the end of the 15 th century and from the time of Louis XI were used iron projectiles heated redhot in a fire. Georges Chastelain [1] states that at the siege of A Audenarde the men of Ghent "with their mortars, cannon and b breech-loaders, battered the said city, and among others threw several redhot iron balls of the size of a silver cup, and set the city on fire.

Note 1.p.258. Chron. de J. D. Lalain.

But let us return to our carriages. To make pointing the p pieces possible, either vertically or horizontally, were first placed two wheels at the front end of the carriage, and this was divided in two superposed parts, the upper one able to d describe a certain arc of a circle (29). The cannon was kept in place on the joined timbers, pivoted on a horizontal bolt placed under the muzzle. The very long train of these timbers formed a lever, and was elevated more or less high by means of iron rods passed through the double racks B. Thus the train could be raised ts A'. The lower part of the carriage rested on the ground and had two iron points intended to prevent the effects of the recoil. At F is reproduced the rear end of the carriage with its two points and the two superposed members. Yet the upper member receiving the cannon, however long the train, much effort was necessary to raise that mass, which

made pointing very slow. Besides, to force back to the powder charge the enormous stone balls then placed in the mortars, it was necessary to incline the gun from the muzzle toward the breech; after each shot it was necessa y to lower that upper member of the carriage to the lower member, load the gun, then point it anew by elevating the train to the desired point. Men sought to make this work easier. Instead of moving the entire upper member on an axis placed under the muzzle of the piece, the lower part of the carriage was made movable, and instead of placing the bolt at the muzzle, it was put under the breech; (30); the effort of raising the gun was thus made much less, because its weight was always transferred to the axle, and the more the train of the carriage was elevated, the less the weight of the cannon acting on the member. These different systems were abandoned about 1530; then to the two wheels was added the third on the train, this caused the separation of it into heavy timbers, between which was placed that third wheel. The piece was pointed no longer by elevating the carriage, but by wedges or screws under the breech of the gun, held on the carriage by means of trunnions, for one will observe that until about the middle of the 16 th century cannon had neither t trunnions nor handles, and that they were hild in the longitudinal groove of the carriage only by iron straps or even ropes.

At the end of the 16 th century bronze cannon were divided into regular and bastard; the regular presented the following varieties; the dragon or double culverin throwing an iron ball of 40 lbs. and reaching 1364 paces of 2.5 ft. each point blank; the regular or ordinary culverin throwing an iron ball of 20 lbs to 1200 paces; the half culverin throwing an iron ball of 10 lbs. to 900 paces; the saker or quarter culverin throwing a ball of 5 lbs. to 700 paces; the falconet or eighth culverin throwing an iron ball of 2.5 lbs. to 568 paces; the ribaudequin throwing an iron ball of 1.25 lbs. to 411 paces, the emerillon throwing 15 oz. of lead to 315 paces. The bastard pieces comprise the flying dragon or double culverin throwing an iron ball of 32 lbs. to 1276 paces point blank; the passe-mur throwing a 16 lb. ball 1120 paces; the passe-volant throwing an 8 lb. ball 840 paces; the extraordinary saker throwing a 4 lb ball 633 paces; the extraordinary falconet throwing a 2 lb. h ball 498 paces; the passager sending a 1 lb. ball 334 paces;

emerillon sending a half lb. ball 294 paces. There were also cannon, that comprised:- the ordinary cannon or batter-wall sending a 48 lb. ball 1600 paces point blank; the hal cannon throwing a 16 lb. ball 850 paces; the quarter cannon called persecutor throwing a 12 lb. ball 640 paces, do. There were also some bastard cannon somewhat larger than the ordinary guns, rebuffes, crepans and verrats, the crepans being half cannon and the verrats quarter cannon.

We do not think it necessary to speak here of the singular inventions to which artillesists had recourse at the end of the 15 th century and beginning of the 16 th, inventions that could only cause terrible accidents and make victims of those employing them, such as the bent guns, radiating guns with a single charge at the centre, the guns with several barrels, etc.

ENGINS OFFENSIFS ET DEFENSIFS. Offensive and Defensive Machines.

We first class in that series of machines the covered battering rams, that were in use among the Greeks and Romans of antiquity, as well as among the Byzantines, and that only ceased to be employed at the beginning of the 16 th century, a also the cats, vines and towers. The ram consisted of a long beam armed with an iron head at its front end, suspended in horizontal equilibrium by ropes or chains, and moved by men by means of ropes fastened to its rear end. By moving this timber back and forth, the surface of the wall was battered, so that it was dislocated and broken in pieces. The men were sheltered beneath a roof covered by green hides, by manure or turf, both to stop the shock of projectiles and to prevent the effect of burning materials cast by the besieged. The entire machine w was placed on rollers or wheels, so as to approach the walls by means of capstans or levers. The besieged sought to break the ram by means of timbers dropped on its head at the moent when it struck the wall; or indeed they siezed that head by the aid of double iron jaws called loup or louve.(Wolf).[1] The ram attacked the gates and they were broken.soon. At the siege of Chateauroux, after Philip August had invested the city, he sent miners to the foot of the ramparts, destroyed the merlons by means of stone-throwers, brought the battering ram before the gate "all plated with iron," caused the movable towers to advance opposite the defenses of the enemy, covered the para-

parapets with a hail of bolts, arrows and balls from slings.[1] The effect of the ram was disastrous for the ramparts not t terraced; breaches were very soon opened by means of that powerful engine in the thick walls, unless the besieged succeeded in neutralizing their repeated strokes; so the besiegers gave all their care to protect this movable beam, as well as the men moving it. To offer the least opportunity possible to the projectiles of the besieged, the covering of the ram was much inclined; they made a sort of large and steep gable roof with a hip on the rear end, the whole covered by very strong timbers reinforced by iron bands, and as stated above, covered by fresh hides of horses and cattle, covered by tamped rich earth with turf or manure.

Note 1.p.280. Old French Note.

Note 1.p.281. Willion le Breton. Philippide. Chant 2.

Fig. 31 shows the woodwork of that machine, omitting the c covering timbers and purlins. The ram A, a beam at least 33 ft. long, was suspended by two parallel chains attached to t the lower ridge-piece, so as to be in perfect equilibrium. To move this beam and produce a powerful shock ropes were fastened to it at C at about one-third its length; they permitted 8, 10 or 12 men to place themselves at right and left of the machine, these men were very regularly placed and worked thus; one foot D remained in the same place, the right foot for the men on the right, the left one for those on the left. The first movement was that represented at E; with the beam in its normal position, it consisted in pulling it backward, and after several efforts, the beam reached the level A′H′. Then the second movement of the men was that at F. The beam then passed over the entire space. The third movement is indicated at G. The head H of the ram striking the wall as an obstacle, the men continued with the first two movements, E and F. It is understood that a movement K L made by a beam 33 ft. long must produce a terreble effect at the base of the wall. The head of the beam was armed with a mass of iron having nearly the f form of the head of a ram. (See detail P).

Cats and vines [1] were nothing more than wooden sheds covered by fresh hides, that were moved forward on rollers to the foot of the wall, permitting miners to undermine the masonry at its base. We have represented one of these machines in Art. vili-

Militaire, Fig. 15. Cats also served to protect the laborers that filled the ditches. Frequently the movable wooden towers that were built before the besieged ramparts took the place of cats in their lower part; so in that case they were termed cat-castles. This enormous machine was employed by the Romans, and Cesar speaks of it in his Commentaries. Men did not fail to make frequent use of it during the sieges of the middle a ages. Suger relates in his Histoire de la vie de Louis le Gros, that this prince besieging the castle of Gournay, after a fruitless assault, caused to be erected a tower of three stories, of a prodigious height, a machine that exceeded the defenses of the castle and prevented the slingers and archers from appearing at the battlements. To the colossal machine was fastened a wooden bridge rising above the ramparts of the place, and when lowered it could aid the besiegers to take the upper galleries. In the poem of the 12 th century of Ogier l'Ardenois, Charles besieging the castle in which Ogier is enclosed, commanded the engineer Malrin, who only occupied 15 days in taking the strongest place. That engineer employed 380 carpenters in building a tower for the assault.(Old French poem) [2]

Note 1.p.263. Old French Note.

Note 2.p.263. Verse 8734 et seq.

As a poet the author may be suspected of some exaggeration in causing 1170 men to enter his tower; but he does not claim that it was movable. Further on he says:- (Old French poem).[1]

Note 1.p.264. Verse 8137 et seq.

One also reads in the Roman de Brut this passage.

"The tower began to approach the wall,"

And the trebuchets to cast stones." [2]

Note 2.p.264. Verse 323.

And in the continuator of Villehardouin:- (Old French text).

Examples abound. These movable towers, cat-castles, were o often made of green timbers cut in the forests near the besieged place,[3] which made their destruction by fire more difficult. They were usually placed on four wheels and moved by means of capstans placed inside the interior itself of the machine, in the ground story. By means of anchors or stakes and ropes these heavy machines were to advance just like a ship by its anchors. The ground was leveled and covered by timbers up to the edge of the ditch. That was filled with a slight slope

from the counterscarp to the foot of the wall. The filling of the ditch was likewise covered by timbers, when the tower was brought to the crest of the counterscarp, then allowed to roll by its own weight, staying it by guys, until against the rampart attacked. The talent of the engineer consisted in well calculating the height of the wall, so that at the proper moment the bridge was dropped on the battlements. A figure is necessary to make us understood. Let (32) a wall A be required to be forced. First of all by means of projectiles thrown by trebuchets and mangonels, the besiegers have destroyed or made useless the defensive galleries B, have filled the ditch D, and have covered the filling by a good inclined floor. The t tower is brought to the point C, started on the floor and rolls down by itself; the projections E of the calculated length butt against the foot of the wall. Their braces G are covered by strong timbers, forming a cat suitable to protect pioneers and miners if necessary. Then the bridge H is dropped suddenly; it falls on the top of the parapet, breaks the coverings of the defensive gallery, and the assaulting forces throw themselves into the upper gallery K. During this time, archers and crossbow men posted at I on the last story cover these upper galleries with projectiles, so that they dominate and disconcert the defenders, who at right and left oppose the torrent of assailant soldiers. Besides the internal ladders, at the moment of assault, numerous other ladders were placed against the rear wall of the tower, left nearly open. We have omitted in this figure the timbers and fresh hides that covered the carpentry, in order to permit the latter to be seen; but we have given in Art. Architecture Militaire, Fig. 16, one of t these equipped towers at the moment of assault. About the middle of the 15 th century, small cannon were placed on the tops of these towers and on the lower floors to batter the foot of the walls and to cover the upper gallery with grapeshot.[1]

Note 1.p.266. Robertus Volturius, de re militari. Paris.1534. Figs. of 1843.

Among machines suitable for making the assault should not be neglected the ladders frequently employed and often arranged in ingenious fashion. Galbert in his Vie de Charles le Bon s speaks of a certain ladder made to scale the walls of the castle of Bruges, that was very wide, protected by high palisades

at its base and furnished at its top with a second narrower ladder to be lowered before or within the walls. The palisades protected the assailants preparing to mount to the assault; the ladder was raised by mechanism, and once raised, the second was lowered.

There are in the Roman of Ogier the Ardenois these verses. (Old French poem).[2, 3]

Note 2.p.288. Verse 8124 et seq.

Note 3.p.288. Verse 8150 et seq.

The ladder furnished with movable shores seems to have been the most ingenious of all those emplived in the assaults. Fig. 33 gives its side elevation at A. The entire system was placed on a carriage with trucks, that was brought to the foot of the wall to be scaled; it was composed of two sides B C with rollers B at the base, connected by a rod; these rollers were made like pulleys as indicated by the detail O, fitting on the timbers D E of the carriage and with two links P at the end of t the rod to which were fastened two ropes, that passed around the directing pullies F and then were coiled on the windlass G. By pressing on this windlass by two bars, the foot B of t the ladder was brought to B′. Then the two pivoted shores H I rose to H I′; i.e., the triangle B H I became the triangle B′ H I′, its base being narrowed, and the top C of the ladder, that rested on a cross-bar K, rose to C′. Then the rope L was pulled to lower the double iron hook rotating at the top of the ladder, so as to fix the machine.(See detail B). The men charged with working the windlass G advanced as the foot of the ladder approached the point B′. This sort of ladder was w wide enough for three men to ascend in front to the assault. Firmly fixed at the base, supported at the middle by the two pivoted shores and hooked at top of the parapet, powerful means were required to disturb these ladders. Besides, during t this work and during an assault, the besiegers covered the r ramparts with a cloud of projectiles, and they took care to surround the machine with great mantlets of wickerwork. There were also used ladders raised in sections, that slid together and thus were easily carried to the foot of the rampart to be quickly raised. The works of the 15 th and 16 th centuries on the military art are filled by models of war machines, and n notably by various inventions of ladders, that it would be i

impossible to employ in practice; so we shall not speak of th them here, the more because where scalades were employed, as for example under Charles V during the war of independence, besieging armies only seem to have used ordinary ladders for scaling the ramparts. The question then as now, was to bring a sufficiently great number of ladders, and rapidly enough to disconcert the defenders, and deprive them of the possibility of overthrowing all at once.

ENGINS DEFENSIFS- Defensive machines.

The sole defensive machines employed during the middle ages are mantlets. The Romans always used them in sieges, and made them of wickerwork arranged in a semicircle and mounted on t three wheels (34), or also of two panels placed at right angles, likewise mounted on three wheels (35). During the middle ages these customs were retained, and were perpetuated in the armies. Archers and crossbow men charged to shoot constantly at the battlements of the ramparts attacked, during the work of the miners or that of the engineers occupied in bringing forward towers, cats and ladders, protected themselves by l light mantlets, like those reproduced in Figs. 36, 37. These shooters must continually change place to avoid the projectiles of the besieged; it was necessary that the mantlets serving them as shelter should be easily traysported. We give in Art. Siege the general arrangement of these means of attack and defense. Before us an illustrious author had recognized t the value of these war machines of the middle ages, and how little they had been studied and appreciated; we owe it to the truth to say, that these first works placed us in the way of the new views presented in this Article. But the art of war of the middle ages would merit a special work; we should be h happy to see the little known side of arcahaeology brought to light by an author competent in these matters.

Note 1.p.269. See Precis hist. de l'influence des armes a feu sur l'art de la guerre, by prince Louis-Napoleon Bonaparte, president of the republic.

ENRAYURE. Platform. Horizontal Frame.

An assemblage of horizontal timbers on which rested the carpentry, and that maintained their horizontal distancer; carpentry might have several platforms for the stories, then are

as many assemblages or rests, permitting the adoption of a new combination, and that connect together the entire system. Spires of carpentry, for example, have several platforms. (Arts. Charpente, Fleche).

ENTRAIT. Tiebeam.

A horizontal timber that serves as base of the triangle formed by a roof truss, and that prevents the spreading of the principals. The tiebeam may be suspended by the kingpost and the hanging rods.(1). A is a tiebeam. (Art. Charpente).

ENTREE. Keyhole.

The name given to the opening for the key of a lock. The k keyhole of a lock means the opening by which is introduced t the key. (Art. Serrure).

ENTRELACS. Interlacings.

Only used in the plural. Thus are designated certain ornaments especially adopted during the Romanesque epoch. Scrolls of honeysuckle ornament that are connected together, bands f for forming varied designs by passing over each other, like lacework, are interlacings in sculpture or decorative painting. (Arts. peinture, Sculpture).

ENTRE-SOL. Entresol. Mezzanine.

A low story arranged in the height of an architectural order, presenting externally the appearance of a single story. Mezzanines were little used in the civil architecture of the middle ages, each story separated by a floor being almost indicated on the exterior by a band. Yet the architects of the middle ages were not always absolute, and however imperative the principles to which they submitted, they knew how to harmonize needs and programmes with the requirements of art; or better said, their art never refuses the true expression of a need. For example, when it was necessary to place small rooms or s servile galleries next the great hall, to which it was useless to give the height of that great hall between floors, these services were then mezzanines. We have given examples of these internal arrangements in Art. Construction, Figs. 119, 120.

ENTRE-TOISE. Tiebeam. Cross-beam. Collar-beam. Header.
A timber that horizontally connects two principals or two principal beams of a floor. The trusses of the roof may receive purlins, that are placed on the principals and supported by blocks, while the cross-beams are joined to the principals by tenons and mortises. In carpentry floors the cross-beams are actual binders. (Arts. Charpente, Plancher).

EPANNELAGE. Blocking out.
This is the preliminary cutting of a moulding or ornament. Today in structures of cut stone, there are set stones merely blocked, the finishing being done on the work, when the construction is erected. Until the 16 th century each stone was set dressed and even carved; thus eidifices never risked remaining merely blocked, as frequently has occurred since. The Greeks and Romans set stones merely blocked, and the finishing was done after setting. There may yet be seen some Greek monuments and many Roman structures, that are merely blocked. The temple of Segesta in Sicily is only blocked. The gate Maggiore at Rome, some parts of the Coliseum, the amphitheatre at Pola, etc., have never been finished.entirely.

EPERON. Projection. Spur.
This word is often employed for buttresses, although the b buttresses and projections are not similar parts; the buttress is an external pier intended to strengthen a wall at a thrust; the name of projection should only be applied to certain projections of masonry, angular in plan, projecting from the external cylindrical surfaces of defensive towers to keep off assailants, and to oppose the effects of battering rams or the work of miners. (These projections are also termed batters. (Arts. Architecture Militaire; Construction; Porte; Tour).

EPI. Terminal. Top.
This name is given to certain ornaments of terra cotta or of lead, that enclose the ends of the kingposts of hip roofs at their projection above the roof. Every hip in carpentry m must join the central vertical kingpost, that cannot be cut off flush with the ridge, since it is necessary for the tenons of the hip rafters to have a strong resistance above the

mortises. A (1) being a kingpost receiving four hip rafters B, one must always leave an end B A, above the tenons so that the connection may be firm. The portion B A then extends above t the covering, and it is necessary to cover it. If the roof is covered by tiles, the covering of B A at the end of the kingpost is of terra cotta; if the roof be covered by slates or lead, the covering of the end of the kingpost is also made of lead, for one cannot place lead on tiles, no more than it is proper to place terra cotta on slates or lead. The architects of the middle ages were pleased to ornament with luxury these projecting ends of kingposts of hip roofs, that are detached against the sky and thus assume much importance. In that they only followed the antique tradition, for the Romans and the Greeks before them took great care to ornament the roofs of their edifices by ornaments of terra cotta or metal outlined against the sky, and in that as in many other things, the pretended imitations of antique architecture attempted since the 17 th century vary somewhat from the models supposed to be f followed.

The terminals of the Romanesque epoch are not preserved till our days. These accessories are fragile, very much exposed to storms, and have been destroyed a long time since with the carpentry that bore them. In reliefs and manuscripts can scarcely be found a trace of these decorations before the 13 th century, and the first times of the middle ages, have not left us in regard to their edifices those medals, that afford such precious data concerning the external appearance of Roman monuments.

It is necessary first to distinguish terminals of terra cotta from those of lead. The oldest terminals of terra cotta are represented in the reliefs of the 13 th century; we know none that may be earlier than that epoch, they appear to be composed of several pieces extending into each other and terminated by a cap. Here (2) is the most common form of the terminals of that epoch. They usually represent a little column with its capital covered by a cone. The profile A B indicates the different parts composing the terminal enclosing the end of the kingpost. The bottom piece is the last ridge tile covering t the end tiles of the hip of the roof.

As architecture became richer and the crownings of edifices became more cut-out, it became necessary to give more import-

importance to those details detached and outlined against the sky. There exist some fragments of terminals of terra cotta from the beginning of the 13 th century in provinces , where the material was employed by skilful hands. Troyes is one of the cities of France where manufactures of terra cotta were particularly flourishing during the middle ages; it possessed a few years since a great number of very beautiful terminals of glazed terra cotta, that have mostly been destroyed or removed. M. Valtat, sculptor at Troyes,has collected one of the most remarkable specimens of this decoration of roofs. It is in one piece not less than 2.5 ft. high, and was terminated by a strong iron rod probably receiving a vane. The base A B is wanting, and we have restored it here to complete this ornament. At the end of the shaft expands a capital with leaves forming a little circular structure terminated by five gables and a cone pierced at top. The whole is lead-glazed green and yellow, and the little openings imitating windows are pierced neatly by means of a cutting tool. It is easy to see that this pottery was modeled by hand, for there appear many irregularities; the work is coarse, and it is the composition and style and not the execution, that recommends our example.The iron rod simply extends into the end of the kingpost of the carpentry as indicated by the section D. This was an ordinary object; one cannot doubt this, when he sees at Troyes and in the vicinity the quantity of remains of pottery of this kind that s still remains on the roofs of houses or the edifices. Ceramics is an art behind the others; makers continue traditions often no longer in harmony with the age; this explains the Romanesque appearance of this terminal, to which cannot be assigned a date earlier than 1220. A certain number of these objects further remained several years in the manufactory before being sold, and it was only later that the potters decided to modify their models. These little shafts supporting small structures were long accepted for the decoration of kingposts, yet about the end of the 13 th or beginning of the 14 th centuries, this type was too much out of harmony with the architectural forms of that epoch; men came to pinnacles of terra cotta to crown hips or hip roofs covered by tiles.

There is seen in the museum of the bishop's palace at Troyes one of these terminals taken from the old city hacc (4); we

believe it might have been made about the middle of the 14 th century, it is square in plan, decorated by little openings o only accented and filled with a brown glaze, four gables and a pyramid with four niches. The upper cross-flower B is broken and the part C of the base is lacking, i.e., the existing portion is that betweer A and B. This terminal is glazed in reddish-brown and yellow, like the tiles of the 14 th and 15 th centuries' it must have been terminated by an iron rod and a vane. Its execution is coarse, made without moulds, the whole seeming made by hand; but it must be recognized, that at the height at which these objects were placed, there was no need of careful execution to produce the effect. Men went to the factory for these terminals, just as one goes today for flower pots and ordinary pottery; and used them such as they were. Soon these forms seemed too stiff and not sufficiently opened, stone pinnacles covered by projecting crockets and r ridges of roofs flowered, the terminals of terra cotta were given an appearance less architectural and freer, it was desired to find perforations and pronounced projections, their principal stem was made more slender; it no longer enclosed the end of the wooden kingpost, but an iron rod.

However the use of tiles was less common, these being replaced by metal or slate; terminals of terra cotta consequently became less common.

We drew at Villeneuve-l'Archeveque some years since a terminal in terra cotta on a house dating from the 15 th century; it was composed of three pieces (5), entirely covered by brown glaze; the joints A and B; the iron rod that held the pottery was fixed on the stump of the kingpost, as indicated at A.

The 16 th century replaced the terminals of glazed terra cotta by terminals of faience, i.e., of enameled clay. The suburbs of Lisieux possessed a great number from the factories of the valley of the Orbec;[1] most of those objects have been purchased by dealers in curiosities, who sell them to amateurs as Palissy faience, and today it is necessary to go farther to find some of these faience terminals of the Renaissnce, so common twenty years since. One of the most remarkable among these products of Norman industry is found at the chateau of S. Christophe-le-Jajolet. We give here (6) a copy.[2] This faience terminal is composed of four pieces, whose joints are at

A, B, C. The whole is strung on an iron rod. The base is yellow spotted with brown, the vase is light blue with yellow ornaments and heads in natural colors, the flowers are white with green leaves and yellow balls, the stem is white, the ball is bistre yellow,and the bird white spotted with brown.

Note 1.p.276. See Bull. mon. of M. de Coumont. Vol. 16. Notes on some ceramic processes of the middle ages.

Note 2.p.276. This drawing was furnished by M. Ruprich-Robert.

The faience factories of Rouen, Beauvais,and Nevers, supplied these objects of external decoration to all the adjacent provinces; unfortunately negligence, love of novelty and the fashion of roofs without any decoration have caused them to disappear, and the museums of those cities have not known how to save some remains. The new ideas, that in the 17 th century tended to take from our national architecture its originality, gradually destroyed that provincial manufacture, prosperous even in the 16 th century. The art of the potter longer resisted that sad influence than any other, and under Louis XIII men continued to make crestings and terminals of enameled or glazed terra cotta, to ornament the roofs of private houses. The museum of the cathedral of Seez possesses a terminal of that epoch, however rude it is, that preserves some remains of those traditions of the middle ages; that is why we present a copy of it here (7). This terminal is entirely covered by a greenish brown enamel.

Lead lends itself much better than terra cotta to the execution of these upper decorations of roofs, so it is employed for making terminals on roofs, always when these are covered by metal or slates. In the 12 th century and before that epoch, there were employed only tiles for covering roofs, and exceptionally lead; slate was in use only in our provinces where schist is abundant. (Arts. Ardoise, Plomberie, Tuile). Then only on monuments built with luxury were placed terminals of lead, and the coverings of metal placed before the 13 th century no longer existing, it would be difficult for us to give examples of terminals preceding that epoch. The oldest terminal that we have seen and drawn is found on the roofs of the cathedral of Chartres;[1] it was placed at the centre of the crossing and might have a height of about 3.2 ft. It was a beautiful work in hammered lead, but very dilapidated.(8). Its cross-

flower was divided into four leaves with four intermediate b buds. A large ring decorated by great beads served it as a base. It is to be believed that its support was a forked iron bar enclosing the head of the wooden kingpost.

Note 1.p.279. This covering of the carpentry supporting it dates from the second half of the 13 th century; the carpentry was burned in 1836.

About the end of the 13 th century slate roofs became very common and replaced tiles nearly everywhere, but to which however Burgundy, Auvergne, Lyonnais and Provence remained faithful. The ridges and terminals of lead then became more common. We still possess a very great number of examples dating from the 14 th century. There exists one of these terminals on the building located behind the apse of the cathedral of Laon. H Here is another (9) that crowns the stair turret of the hall called of the Maccabees, dependant on the cathedral of Amiens. This terminal is entirely hammered and is modeled with extreme care; it dates from the epoch of the construction of the hall, i.e., about 1330. At A we present the section of the stem at a b and the plan of the ball made of two shells soldered together. The terminal is maintained by an iron rod fastened to the head of the kingpost of the carpentry.

On the north gable of the transept of the cathedral of Amiens is still seen a very beautiful terminal of lead with two rows of leaves, that dates from the end of the 14 th century or beginning of the 15 th. This terminal crowns a half timber construction that replaces after that epoch the stone gable. Much too delicate for the height at which it is placed, it is better suited for crowning the roof of a chateau. We give a reproduction (10); each group consists of three much divided leaves, strongly modeled by hammering, and forming in plan two changed equilateral triangles. Under the ring are soldered small leaves of cast lead; indeed after the 15 th century is seen cast leadwork, employed at the same time as hammered leadwork. But we shall treat this matter in detail in Art. P Plomberie. It is evident that the lead terminals follow the transformations of the architecture; this becomes lighter and more open, these crownings become more slender and leave more openings between their ornaments, seeking for affected details. Still the outlines are always happy and are detached against

the sky so as to leave their importance to the principal masses.

The hospital of Beaune, founded in 1441, still retains on the half timber gables of its great dormers, on its turrets and on the hips of its roofs beautiful terminals of the 15 th century ending with armorial vanes. These terminals are partly of hammered lead, partly of cast lead. We give here (11) a copy of one of them. The upper groups of leaves, whose detail is seen at A, are of hammered lead, the crown and canopy, detailed at B and C, are formed of bands cast in moulds and soldered to circular rings. The base of the terminal is entirely made of hammered work, except the attached sun, which is cast. Burgundy was in the 15 th century a rich and powerful province, and its inhabitants could allow themselves to ornament the m roofs of their mansions and houses by beautiful leadworkl while in the North of France, ruined by the wars of that epoch, could not devote itself to luxury in private structures. Thus in spite of the sort of fury exhibited for more than a century to suppress the old ornamental crowns of roofs, there yet remain in the cities of Burgundy some forgotten examples of these terminals of the 15 th century.

At Dijon, several exist on private houses, notably on Petite Rue Pouffier. (12). At A we give the half plan of the king-post, whose base is a concave curvilinear triangle under the ring. Dating from the 14 th century, one very frequently finds the rings of terminals decorated by prisms or cylinders, that intersect them horizontally, and that terminate by a flower or quatrefoil. These kinds of rings produce a very happy outline. It should not be forgotten to mention here some lead t terminals, that surmount still the roofs of the mansion of Jacques Coeur at Bourges, whose bases are ornamented by leaves in low relief, shells and hearts. Frequently lead terminals were painted and gilded, which adds much to the effect, that they produced at the tops of the roofs.

The epoch of the Renaissance, that in changing the details of French architecture still retained the general system, especially in private houses, and did not neglect the luxury of leadwork. As before, the roofs were enriched by crestings and terminals. Men returned then to hammered lead and abandoned almost everywhere the process of casting. Several chateaus and mansions of that epoch still retain very beautiful termi-

terminals ornamented by fruits, capitals, leaves and even by figures, the whole hammered with much skill. Among these terminals may be cited those of the mansion du Bourgtheraulde at Rouen, the chateaus of Amboise and of Chenonceaux, the palace of justice at Rouen. Very beautiful ones, though mutilated, are seen on the dormers placed at the base of the spire of t the cathedral of Amiens in the valleys.

We reproduce one (13) of these terminals whose leadwork is hammered by a very skilful hand. It would be difficult to t tell what Cupid is doing on the roofs of Notre Dame of Amiens, but that figure is found frequently repeated at that epoch at the tops of terminals. One also sees some of those children drawing the bow on the houses of Rouen built at the beginning of the 16 th century. At the top of the chevet of the apsidal chapel of Notre Dame of Rouen exists a very beautiful terminal of the 16 th century, which represents the Holy Virgin holding the Child. As leadwork, it is a remarkable piece.

At the end of the 16 th century, the terminals lost their special character; they represent vases of flowers, little columns with capitals, cooking pots, and chimeras attached to balustrades. As one approaches the 17 th century, the art of leadwork continues to become weaker, although under Louis XIV were again executed very beautiful works of this kind, but then it was only applied to great monuments, to princely habitations; it is then a luxury not permitted to the simple private individual. (Arts. Crete, Girouette).

Note 1.p.287. It is necessary to say that quite recently th this art or industry, if you prefer, has resumed a certain importance. This is again one of the souches of wealth, that we owe to the study of the arts of the middle ages.

ESCALIER. Stairs. Stairway. Staircase.

We shall distinguish between external stairways (that should not be confused with flights of steps) from internal stairs, stairs with straight flights from stairs with turns and circular, stone stairs frsm stairs of wood. In Roman edifices, excepting theatres and amphitheatrer, the stairs are very narrow and not numerous. Besides, the Romans employed stairs with st-straight flights and screw stairs; but the do not appear (at least in interiors) to have ever regarded the stairway as a

motive of monumental decoration, as done in modern times. The stairs of an antique edifice are a need satisfied in the simplest manner, and a means of communication from one story to another, nothing more. We shall not decide in this whether the a ancients were wrong or right; we only state the fact, so that one cannot accuse the architects of the first times of the m middle ages as remaining in that far below their masters.

Besides, the architects of the middle ages, like the Roman architects, had never established in a building a stairway, whose flights would obstruct the arrangement of openings, as freely done in our time, even in great edifices. The Romans reserved the monumental arrangement of the stairs for external flights of steps under the open sky. In the interior they always placed the flights perpendicular to the front wall, so t that the heights of the landings could accord with the heights of the floors, and consequently with the arrangement of the o openings; but we shall return to that important question.

However little one may be occupied with internal arrangement, he knows how difficult it is to properly arrange the stairs, either to satisfy the programme, or not to interfere with the external or internal arrangement of the architecture. The ancients did not solve the difficulty; this was a means of not having to solve it.

The most common Roman stairs is arranged thus.(1). It is c composed of two flights separated by a division wall, and first reaching the mezzanine landing A, the second landing of the second story B, etc. The steps are then borne by the rampant vaults, if very wide, or simply arranged at the ends in the walls, if the treads are narrow. Thus are conceived and executed the stairs of baths, theatres and Roman amphitheatres. Men sought no other system of stairways in the first monuments of the middle ages. But it is easy to see that these double flights always led to over the starting point, which in many cases could not be done in the arrangement; then men had recourse to the screw or snail stairs, that present this advantage of ascending in a small area to all points of the circumference of the cylinder in which rise this sort of steps. These first principles being established, we shall occupy ourselves at f first with stairways with straight flights, external and covered or uncovered.

ESCALIERS EXTERIEURES. External Stairs.

Although this sort of stairs is rarely constructed today, it must be recognized that they were very convenient, because interfering in nowise with the internal arrangement, and did not intersect the building from top to bottom, thus intercepting the principal communications. One of the oldest and most beautiful stairways so arranged is still to be seen in the enclosure of the buildings of the cathedral of Canterbury. This stairway was built in the 12 th century, and is situated near the principal entrance, leading to the reception hall (hall of the stranger); it is composed of a broad flight perpendicular to the entrance of the hall with upper landing; it is c covered, and the roof with horizontal plates, is supported by a double open and very rich arcade, whose columns diminish a according to the rise of the steps.[1]

Note 1.p.289. See Some Account of Domestic Architecture in England, from the Conquest to the end of the 13 th century, by T. Hudson Turner. J. Parker. Oxford. 1857.

Most great halls of castles were situated in the second story, and one ascended there either by wide flights of steps, or by narrow covered flights, beside or perpendicular to these halls.

The great hall of the castle of Montargis, that dates from the second half of the 13 th century, possessed a stairway with three flights with a gallery of communication supported on arches. (Art. Chateau, Fig. 15). That stairway was arranged in such fashion, that from the great hall A (see plan, Fig. 2), one could descend to the area of the court by the three flights B, C, D. It was covered by wooden roofs placed on columns and piers of stone.[2] In palaces, this sort of stairs was called the steps in particular. The flight had the name of "epuiement;"[3] (old French poem).

Note 2.p.289. See Du Cerceau, Des plus excellens batiments de France.

Note 3.p.289. Lai d'Yweyec, poems of Marie de France, 13 th century.

The coverings of these narrow ramps were either of wood, as at Canterbury and Montargis, or vaulted as much later at the Chambre des Comptes and at S. Chapelle of Paris. These two last stairs ascended along the building. That if the Chambre

des Comptes, erected under Louis XII, was a masterpiece of e elegance; it landed at a portico A opening on the apartments. (Fig. 3, plan). This portico and the porch B were vaulted, t the flight was covered by a wooden ceiling. On the front of the porch was seen in relief a crowned shield of arms of France, having as supports two winged stags, the crown passing a around their necks, and the tabard of the herald of arms of France displayed behind. Beneath the shield was a porcupine surmounted by a crown, with this legend beneath. (Latin verse). The whole on a ground spotted with fleur-de-lis and crowned dolphins. The fleurs-de-lis were then carved on the tympanums of the arches and on the pilasters. The solid balustrade presented in relief Ls passing through crowns, then dolphins.[4]

Note 4.p.289. See Topog. of France; Imp. Library.

To ascend to the upper galleries of fortifications were established after the 12 th century long straight flights along the curtains with a parapet at the top. The steps then rested on arches, and were always moulded at the riser, which gave greater breadth to the step and produced a very good effect, very clearly indicating the purpose of these flights, very l long if the upper gallery was very high above the ground inside the city.

At Aigues-Mortz, Avignon, Villeneuve-les-Avignon, Jerusalem, Beaucaire, Carcassonne, are still seen a number of these external uncovered stairs, that have a very monumental appearance. (4).[1] But if frequently occurred for want of room or to avoid the construction of these arches, or when it was necessary to ascend along a very high rampart to the top of a square tower, the steps of uncovered stairs were corbelled. To give these steps sufficient projection to allow two persons to pass and for perfect stability, the architects obtained the desired projection by a very ingenious procedure in construction. Each step was cus as indicated in the sketch A (5), the part B being destined to be engaged in the wall. Setting the steps so combined on each other, so that the point C falls on the point D, they were always supported by a series of steps presenting a solid corbelling as sohown in the perspective sketch G, the elevation H and profile K. One of these stairs, perfectly executed, is still seen in the interior of the socalled tower of Orange at Carpentras (beginning of 14 th century).

Ordinarily for stairs to be easily practicable, it is necessary for each step to have as width the length of a man's foot, say 11.0 to 11.8 ins., and a height of 5.9 to 7.9 ins. at most, which gives an inclination of about 22 degrees. But sometimes space is lacking to obtain such a gentle slope, and one is compelled, especially in fortifications, to ascend at an angle of 45 degrees, that gives steps as wide as high, making the ascent dangerous or very toilsome. In such a case the constructors, observing correctly that one only placed one foot at a time on each step, either to aslend or descend, and consequently that it was useless for a step to have the width required for setting the foot along its entire length, those constructors arranged a wedge-shaped step, as indicated in Fig. 6, so that the two steps taken together would have 11.8 ins rise and tread at one end, which allowed the flight of stairs to be ascended within an angle of 45 degrees. But it was always to place the left foot on the step A, and the right foot on the step B in descending, or the reverse in ascending. The perspective C will make understood the system of these steps.[1] One will recognize here, that subtlety was not lacking in our architects of the middle ages. But these last examples furnish only service stairs.

Note 1.p.291. From the ramparts of Carcassonne, end of 13 th century.

Note 1.p.295. A stairs of this kind is still seen in the up upper parts of the church S. Nazaire of Carcassonne, and at Notre Dame of Paris in the galleries of the transepts.

ESCALIERS INTERIEURES. Internal Stairs.

That is, serving several stories of a building, placed within enclosures comprised in the structures or added thereto. As we have already seen, screw stairs were employed by the Romans; the architects of the middle ages adopted that system in preference to any other, varying the dimensions of the stairs at the newel according to the services that they must sa satisfy. This sort of stairs presented several advantages important to mention:- 1, they could be enclosed within the structure or be attached to it only by a small segment; 2, they occupied little area; 3, they allowed doors to be opened at all points of their circumference and at all heights; 4, they were easily lighted; 5, these were of simple construction and

easily executed; 6, they were inclined gently or rapidly as desired; 7, for castles or towers, they were barracaded in a moment; 8, they ascended from the ground to considerable heights without affecting the stability of the adjacent construction; 9, they were easily repaired.

The oldest screw stairs of the middle ages consist of a newel of cut stone, and of a round tower structure, and of a helical tunnel vault built of rubble, resting on the newel and the internal cylindrical surface. That vault supports the stone steps with edges set on the radius of the circle. Fig. 7 represents the plan and section on the line A B of the plan, one of those stairs so common in the edifices of the 11 th and 12 th centuries. The external door of the stairs being at D, the first step is at C. These steps are set on a solid as far as the line G; beyond this commences the relical vault r represented in the section. The drums of the newel bear a small projection H to receive the springing of the tunnel vault, t that on the other side is engaged in the cylindrical wall I. The steps are set on the extrados of the rampant tunnel vault, and are composed of one or several pieces for each. Generally these rampant vaults are very rudely built of small rubble s set on centerings. The vaults of the abbey church of Eu, which date from the 12 th century however are executed with great precision, but the Normans were then very careful stonecutters. Here in Fig. 8 is how are cut the drums of the newel that receive the springing of the rampant tunnel vault; it also occurs that the support of the vault is notched into the cylindrical newel, which weakens it much. This sort of stairs rarely exceeds 3.3 ft. length of step, and is often less, the cylindrical enclosures having only about 5.9 ft. diameter, from which deducting the newel, in this kind of stairs at least o one foot in diameter, there remains for the steps at most 2.6 ft. One soon recognized that the rampant vault could be omitted; when at the beginning of the 13 th century stone was quarried in larger blocks than ever before, it was found simpler to make a part of the newel on eamh step, to lap them a little on each other, and to arrange a bearing extendinm some ins. into the cylindrical wall of the enclosure. This procedure a avoided centering and forms and much work at the place, it a also had the advantage of connecting the newel with the wall

by all the steps, that formed as many shores. These steps could be cut in advance from a single drawing, and a stair could be built very rapidly. One should not lose sight, that among so many innovations introduced into the art of building by t the lay architects of the end of the 12 th century, the necessity of quickly attaining a result, in brief of building quickly, was one of the most apparent needs.

Fig. 9 gives the plan and section [1] of one of these stairs. The external door is at A, the first step being at B. The layers are indicated by the dotted lines, and the detail C presents one of the steps in perspective with the dotted lap of the succeeding step. Sometimes to facilitate passage the steps are chamfered beneath as seen at D. The dimensions of these stairs vary, the steps of some are only 20 ins. long, the largest are not more than 6.6 ft., which required very long stones; thus to make the steps of the grand stairway of the Louvre, Charles V was compelled to purchase old tombs at the church of holy Innocents,[1] probably because the quarries of the Paris lias could not supply at that time the number of blocks of the desired dimensions; in fact this stairway was very wide; we shall return to it. In interiors of castles screw stairs were singularly multiplied; besides those ascending from the ground and serving all the stories, there are some that established in the thickness of the wall communication between only two stories, and used only by the persons occupying these superposed apartments. Concerning the dominion that queen Blance of Castile had retained over the mind of her son, Joinville relates:- "That the queen Blanche would not allow by her power, that her son should be in company with his wife, nor for him to sleep with her at night. The place where it pleased her most to live was at Pontoise, between the king and queen, because the chamber of the king was above and the chamber of the queen was below (her own). And having them that their conversation should be on a screw stairs descending from one chamber to the other; and these arrangements were made in advance, so that when the ushers saw the queen (mother) come into the the chamber of her son the king, they struck the wainscot with their rods, and the king ran into his chamber, for fear that his mother should not find him there; and thus did the ushers of the chamber of the queen Marguerite when the queen (mother)

Blanche came there, so that she should find there queen Marguerite. Once the king was beside the queen his wife, and she was in two great danger of death, for she was injured by an infant, that she had had. There came queen Blanche, took her son by the hand and said to him; come away, you do not belong here." [1]

Note 1.p.297. The section is mode o.r o b with elevotion of the newel to show the lopping of the steps.

Note 1.p.298. Souvol.

Note 1.p.298. Memoires du sire de Joinville, published by F Fr. Michel. p. 190. Paris. 1858.

These stairs, placing in communication two superposed rooms, were not always made at the expense of the thickness of the walls; they were visible in part, placed in an angle or along the wall of the lower chamber and lighted from that room. In this respect it is important to be impressed by the principles, that directed the architects of the middle ages in the c construction of stairs. These architects never saw in stairs anythiyg but an indispensable appendage to every edifice composed of several stories, an appendage to be placed so as to be most convenient for the service, as one places a ladder b beside a building under construction, just where the need is felt. The idea of making the stairs a sort of theatrical decoration in the interior of the palace, of placing that decoration in a symmetrical manner to only reach secondary services, taking an enosmous area to develop double flights, that idea never entered the mind of the architect of antiquity or the middle ages. A stairway was only a means of reaching the upper stories of a habitation. Besides the great halls of castles were always placed about in the ground story, i.e., above a low story generally vaulted, a sort of cellar serving as a storehouse. The floors of the great halls were reached by broad flights of steps, like those of the palaces of Paris and of Poitiers, or by external flights as at the castle of Montargis. (Fig. 2). Stairways properly socalled, then generally served only the private apartments. Every great assemblage, destival, ceremony or banquet, was held in the great hall; it had not been utilized to establish long steps for the stories frequentel by servants. the important matter was to arrange these steps near the rooms to which they must give access.

This explains the great number and narrowness of the stairs of castles until the 1; th century. Still we have just stated, that at the Louvre of Charles V had already caused the construction of a great winding stairway to ascend to the upper s stories of the palace; but that was an exception, so this stairway passed as a work without its like. Sauval [1] has left us a very extended description of this st irway, which merits be-being given entire.

Note 1.p.300. Hist. de lo ville be Poris. Vol. II, p. 23. "The grond stoirwoy, or rother the grond screw of the Louvre," (since ot thot time the nome of stoirwoy wos unknown), "thot greot screw," I soy, "wos built in the reign of Chorles V, o ond directed by Roymond du Temple, moson in ordinory of the king.[2] Now it is necessory to know thot the orchitects of post centuries never mode their stoirs stroight nor souore, nor in two, three or four flights, os these hod not then been invented,[3] but olwoys circulor ond winding, proportioning the best possible their dimensions to the size of the houses.[4] The greot screw stoirs of this poloce wos oll of cut stone like the rest of the building, ond the some os the others of thot time; it wos terminoted by onother very smoll (screw), olso oll of stone ond of like form, thot led to the terroce (by which wos crowned the greot stoirwoy); each step of the little (screw) wos three feet long ond one ond o holf ft. wide, ond for those of the greot one, they were seven ft. long by one holf thick, with two ond o holf ft. treod next the circulor woll enclosing it."

Note 2.p.300. Roymond du Temple wos sergeont-ot-orms ond ot the some time moster of works of king Chorles V.

Note 3.p.300. Souvol is here in error, these kinds of stoirs were invented in the Romon epoch; but in truth, the orchitects of the middle oges olwoys preferred the screw stoirs, from the motives just deduced.

Note 4.p.300. Souvol in this does justice to our old mosters of works, who built their stoirs proportioned to the services thot they must sotisfy.

"It is seen in the registers of the Chambre des Comptes, t that these together rose 94.5 ft. high,[5] that the great (screw) consisted of 83 steps,[6] and the small one had 41;[7] they were made in the usual way of stone brought from the quarries around

Paris. And since to do this these quarries had been exhausted, in order to finish they were compelled to have recourse to the cemetery of S. Innocents, and trouble the repose of the dead: so that in 1365 Raymond du Temple, director of the work carried away 20 tombs on Sept. 27 th, that he purchased for 14 Paris sous each from Thibault de la Nasse, warden of the church, and finally caused them to be cut by Pierre Anguemond and Jean Golombel to serve as a landing.

Note 5.p.300. I. e., the last step of the stairway was about 65.6 ft. above the ground of the court, and thus must serve two stories above the ground story together with the terrace.

Note 6. p.300. At 0.5 ft. each, this makes about 43.6 ft.

Note 7.p.300. At 0.5 ft. each, this makes about 21.7 ft. T These measures in detail accord with the general measure and produce about 65.6 ft.

"We saw it (that stairway) destroyed in 1600, when Louis XIII caused the edifice of the Louvre to be resumed under the direction of Antoine Lemercier. To make it more visible and easier to find, master Raymond placed the masterpiece entirely in the court,[1] against the body of the building that looked on the garden;[2] and to make it more superb (the stairway), n he enriched the exterior by low reliefs and by 10 great figures of stone, each covered by a canopy, placed in a niche and supported on a pedestal; at the second story beside the door were two statues and two sergeants-at-arms made by Jean of S. Romain,[3] and around the enclosure were distributed outside with neither order nor symmetry, from top to bottom of the enclosure, the figures of the king, the queen and their male children;[4] Jean of Liege worked on those of the king and queen; Jean of Launay and Jean of S. Romain divided between them the statues of the duke of Orleans and of the duke of Anjou; Jacques of Chartres and Guy Dammartin, those of the dukes of Berry and of Burgundy; and these sculptors had 20 francs in gold or 16 livres Parisis for each figure. Finally, that screw (stairs) was terminated by figures of the Virgin and of S. Jo-John of the design of Jean of S. Romain; and the gable of the last window was covered by the arms of France,[5] by fleurs-de-lis without number,[6] that had as support two angels and for an apex a crowned helmet, also supported by two angels and c covered by a bell decorated outside by fleurs-de-lis. A serg-

sergeant-at-arms 3 ft. high and sculptured by S. Romain guarded each door of the apartments of the king and queen opening from that stairway; the vault ending it had 12 ribs, and on the boss were the arms of their majesties, and in the compartments (fillings between the ribs) those of their children,[1] and was wrought (the sculpture of that vault), much by the s same S. Romain as by Dampmartin, for 32 livres parisis or 40 francs in gold."

Note 1.p.301. This was indeed the end proposed by the architects of the middle ages, Further, by thus placing the great stairways as masterpieces, they did not disturb the internal arrangement, had as many windows as desired, and arranged the landings without difficulty.

Note 2.p.301. I.e., meaning within the building on the north. (Art. Chateau, Figs. 20, 21, 22).

Note 2.p.301. It is evident that Raymond signed his work by thus placing two sergeants-at-arms at the sides of the principla door opening in the second story of the stairway.

Note 4.p.301. Sauval evidently means here, that these last statues were set according to the tread of the stairs. Indeed, in these screw stairs the architecture followed the slant of the steps, and the statues must rise at each pier to harmonize with the architecture.

Note 5.p.301. The gable of the last window.

Note 6.p.301. Charles V at first did not charge the shield of France with three fleurs-de-lis, this change in the arms of France was therefore only later than 1365.

Note 1.p.302. There can only be a question here of the vault raised at the top of the little screw.

It is necessary to add to this description, that this stairs communicated with the great tower of the Louvre by means of a gallery, that must have been built also under Charles V, for from the time of Philip August the keep was entirely isolated. Let us then attempt to restore this very interesting part of the old Louvre by the aid of these exact statements and similar materials, that remain to us in the castles of the 15 th and 16 th centuries. The great winding stairway of the Louvre was entirely detached from the building at the north, and was only joined to it by a sort of landing: this results from the text of Sauval; on the other side the stairway was in commun-

communication with the keep by a gallery. This gallery must n necessarily form an open portico in the ground story, to not intercept the communication from one court to the other. Arranging then the spaces necessary for the entrance of the portico and the entrance into the north building, taking account the length and width of the steps, noting that on the exterior the architect was able to place 10 great statues around the ground story in the niches surmounted by canopieu, and that consequently these figures could only be flaced on the fronts of the buttresses, and taking into account the 12 ribs of the vault mentioned by Sauval, of the length and width of the steps of the little screw, we are led to trace the plan of the ground story, Fig. 10. At A is the connection with the north building. At C is the portico supporting the gallery connecting the stairway to the keep. The first step is at D. Up to the landing E, taking into account the tread of the steps, we find 16 steps. Sixteen more steps lead to the second landing placed over the vault F. Sixteen steps arrive at the third landing over that at E. From this third landing one ascends one flight to the fourth landing over that at E by 35 steps, a total of 83. The central newel, large enough to support the little upper stairs, must be opened in the ground story to allow direct passage from the portico C to the building B. Above this open newel could be intended, as frequently practised, to receive lamps to light the steps at night. The first flight was probably set on a solid or on low vaults; the second rested on v vaults G, that permitted passing around that flight. Our plan gives us at H 10 buttresses able to receive 10 great statues. A section, Fig. 11, made on the line C B, explains the revolutions of the flights and the various landings on a level with the stories of the building B. That indicates to us the structure of the open newel, and at K the level of the last landing of the grand stairway, starting from which the small screw begins to ascend, having 41 steps up to the level of the upper terrace. This little screw has its windows in the enclosure of the great stairway by means of stepped arches. It is unnecessary to say, that we do not pretend to present these Figs. as an accurate drawing of this monument destroyed from the 17 th century, and of which no drawing remains; we attempt here to summarize our study and different combinations em-

employed by the architects of the 14 th and 15 th centuries, when they desired to give to their stairways an entirely monumental appearance. One understands very well how Raymond du Temple procured with difficulty such a considerable number of steps and landings of great dimensions, able to offer a perfect resistance, since according to the method then adopted, these steps, excepting those of the two first revolutions, were only supported at their ends. As for the landings, that it would have been impossible to make of a single slab, we have assumed them to be supported, either by vaults or by open arches, as indicated by the perspective view (12) taken below the upper landing.

The architects had become very skilful geometrical draftsmen from the end of the 13 th century, and found in the composition of stairways a subject suitable to develop their knowledge and arouse their imagination. Their system of construction a and their style of architecture lent themselves marvellously to the use of complex combinations, learned and impressed by great freedom; thus (although the existing monuments are unfortunately very rare), the descriptions of castles and monasteries mention remarkable stairways.

For example, these great winding stairs of palaces often had a double revolution, so that men could descend by one and ascend by the other without meeting or even seeing each other. At other times two screws rose, one within the other; one in the inner, and the other in the outer enclosure; a combination of which one can form an idea, by assuming that the little screw in the section Fig. 11 descends to the ground story. The internal screw becomes a service stairs, and the outside winding stairs is a stairway of honor. Independently of the advantages to be derived from these combinations, it is certain that the architects, as well as their clients, were pleased by these refinements in construction, in the castles where the days s seemed very long, these oddities and surprises were so many distractions from the monotonous life of the owners and their guests.

"One saw at the Bernadins of Paris," says Sauval,[1] "a screw turning around a double column (newel), where one enters by two doors, and where he ascends by two ways without one being able to be seen in the other; that screw has 10.7 ft. diameter,

and each step has a height of 8 to 9 incs. The steps are chamfered and are not covered by other stones. This is the simplest stairs and the rarest in Paris, all the steps are chamfered underneath. Its beauty and its simplicity consist in the treads of both, showing about a foot, that are indented, wedged, fitted, inset, dowelled into each other, binding each o other in a manner as firm as pleasing. The steps at the other end are supported by the enclosing wall of the tower; these t two stairs equal each other in all their parts; the style of the newel is similar from top to bottom, and the steps are e equal in length, breadth and height. The church and the stairs were commenced by Pope Benedict XII of that name, of the order of S. Bernard, and continued by a cardinal of the same order named Willian. These stairs have only two windows, one lighting both at top, the other at the bottom.[2]" In seeking to explain by a Fig. the description by Sauval was made the plan. (13). At A and B are the two entrances, at C and D the first two steps; the number of steps to ascend from C to E, considering the height of these steps, allows height under t the tread F for taking the second flight D; the flights thus continue to ascend by one passing beneath the other. It is c clear that two persons ascending from C to D could neither see nor meet each other. Sauval also describes very pretty stairs found at S. Mederic of Paris, and that date from the end of the 14 th century. Here is what he says:-

Note 1.p.306. Hist. et antiq. de la ville de Paris. Vol. IV; Vol. I, p. 435.

Note 2.p.306. It was in 1338 that Pope Benedict XII commenced the church of Bernardins of Paris.

Note 1.p.307. Hist. et antiq. de la ville de Paris. Vol.I p.438.

"There exist two S. Gilles' screws en the two turrets at t the two sides of the masterpiece window. One is prismatic and the other is round. Both were designed by a very learned architect, greatly skilled in stonecutting. The round one is covered by a spherical or shell vault, so well and so smoothly c constructed, that it is difficult to find one whose very soft and bold lines may be better designed or better executed. Its beauty consists especially in six doors that all meet together at the same place on the same landing, as well as the lines of

their jambs, and this without confusion, a surprising and admirable thing. The round column and this screw in some places is twisted or wavy, and although the lines start from two edges where the wave stops, they are always so well designed, t that the vault is always and everywhere of a similar arrangement.

The other prisamtic screw is sometimes pentagonal and sometimes hexagonal. Its newel is very slender and its edges are sharp, and it is designed from top to bottom with the same d delicacy and excellence as the other. The marvel of these two screws consists in their smallness and the tenness of the w walls supporting them, not exceeding 9 ins. thick."

We should not end if we wished to cite all the texts relating to the stairs of the middle ages, and especially those of the beginning of the Renaissance, for it was at that epoch t that were built the most beautiful and surprising winding stairs in the residences of the nobles, the mansions and even t the monasteries. In the description of the abbey of Theleme, Rabelais could not fail to mention a masterly winding stairs, "a hundred times more magnificent" than that of Chambord. "In the middle of these buildings," says he,[1] "was a marvellous one, whose entrance was from the exterior of the building by an arch 33 ft. wide. The same was made in such symmetry and capacity, that 6 men-at-arms with lance on thigh in front could ascend above the entire building."[2]

Note 1.p.308. Book I. Chap. 53.

Note 2.p.308. Evidently Rabelais in writing this had the memory of the general stairway in mind; yet it is surprising that he did not mention the double flight.

We have seen how Raymond du Temple arranged the grand stairway of the Louvre outside the buildings to as not to be restricted in the arrangement of the entrances, the passages of the flights and the landings. This method was also excellent and long persisted in the construction of the habitations of the lords; we see it adopted in the chateau of Gaillon (14). Here the principal stairway was placed at the reentrant angle formed by two porticos E and F. One can take the stairs by entering two external arches A, A, or by two arches B, B, opening from the portico, the first step being at D. This arrangement allowed in the upper stories one to enter the galleries by an opening pierced in the angle at G.[1] Such a stairway could no-

nowise restrict the enternal arrangements. At Plois we find a stairway independent of the building and placed at the middle of one of the wings instead of being erected in an angle. In his construction of the palace of the Tuileries, Philibert Delorme had still retained this tradition of the grand winding stairs of the middle ages, and his stairwan placed in the pavilion called the Horloge today, passed for a marvel of architecture, like that of Chambord. Further, the stairways of Gaillon, Blois, Chambord and the Tuileries were terminated by lanterns, which like that of the grand stairway of the Louvre, crowned the top and gave entrance on a terrace.[2] Although sometimes these screw stairs were inserted within the structure, but so that they retained their independent ascents. One finds that arrangement adopted in châteaus of the 15 th and beginning of the 16 th centuries. Then the winding stairs, instead of being outside the portico as at Gaillon, allowed the portico to pass before it. Fig. 15 presents the plan of the stairway established in that manner. A portico A B is placed in t the ground story before the occupied rooms. The stairway is recessed and square, its entrance at E and the first step at C. In the angles of the square trumpets extended to a spiral cornice and suppor the angle steps, which are longer than t the others. Thus the persons ascending or descending profit e entirely by the square enclosure, and yet the steps are all of the same length and are chamfered beneath, as if they swung a around the cylinder. The section of this stairway made on the line A B, Fig. 16, clearly indicates the arrangement of the flights, their balustrades, and the ends at the ground of the portico, at the mezzanine at G, and the second story at H. Th There exists a stairway arranged absolutely similar to this in the chateau of Chateaudun.[1] But in the winding stairway of Chateaudun the angle trumpets extend from the square to the octagon, and corbels set in the angles of the octagon support the spiral cornice, whose horizontal projection being a perfect circle supports the ends of the steps. A view taken at the height of the first revolution of the stairway of Chateaudun, Fig. 17, where this revolution intersects the portico of the ground storw in its height, illustrates the arrangement of the trumpets, corbels, the spiral cornice and the steps chamfered beneath. This arrangement is further represented in horizontal

projection in the plan. (18.

Note 1.p.309. See Les plus excellents botiments de France, Du cerceou.

Note 2.p.309. At the poloce of Tuileries, the lontern crowed the dome flonked by four little lonterns in form of wotch-towers.

Note 1.p.311. This choteou wos never finished, ond belongs to the duke de Luynes, the portion to which the stoirwoy pertoins dotes from the first yeors of the 16 th century.

The trumpets of the stairway of Chateaudun are jointed; they are flat arches slightly inclined toward the angle; this stairway was of sufficiently great diameter to require that jointing. In screw stairs of less extent, the corners extend from the square to the octagon and do not have so much importance: these angles only form a cut-off corner so as to give in horizontal projection an octagon with four large and four smaller sides. Then these trumpets or rather flats are cut from a single stone. The stairway of mansion de la Tremoille at Paris [1] gives in plan a square with a large cut-off angle, the three angles remaining in the interior beneath the steps were finished with little pendentives cut in a single sculptured stone. We give in Fig. 19 one of these pendentives. In these angles were placed the torches intended to light the steps. These t torches were either placed on little corbels, sometimes in l little niches, or were fixed to the walls as arms.

Note 1.p.312. Demolished in 1840; some frogments of thot m monsion ore deposited ot the Ecole des Beoux Arts.

The texts previously cited indicate how much in habitations of nobles, men adhered to giving (at least from the 14 th century) an appearance of luxury to grand stairways. The architects displayed the resources of their imaginations in the vaults covering them, and in the design of the newels. There e exist still in palaces in Rue du Petit-Lion-S. Sauveur a great tower, that formerly belonged to the mansion that the dukes of Bungundy possessed in Rue Pavee-S-Sauveur. This tower is built on a rectangular plan and crowned by machicolations, contains a beautiful winding stairway closed at top by a vault springing from the newel; the ribs of this vault are pointed arches and represent the oak limbs from which extend leafy branches under the vaults.[1] The newels of the primitive screw stairs,

either supported a spiral vault (Fig. 7), or formed a part of the step themselves (Fig. 9). When a greater diameter was given to these stairways, it was no longer posseble to include the newel in the step; the newels were enlarged to avoid the narrowness of the steps near the centre, and they were engaged in this newel built in courses, or indeed also the newel was composed of large stones set on edge, as done for the posts of screw stairs in carpentry. Then these newels were inriched by delicate sculptures, that were sometimes perforated, and where the stonecutters had opportunity to make proof of science. Th These newels supported hand-rails cut in the mass of projections in form of spiral bands to receive the small ends of the steps.

Note 1.p.313. See in Itineraire archaeologique de Paris, by M. de Guilhem, 1855, p. 288, a description of that tower and a view of the stairway.

The newel of the stairway of Chateaudun given in Fig. 17, i is covered by very delicate ornament, it is constructed in hi high courses; we give in Fig. 20 a portion of it. At A is the hand-rail and at B a band receiving the steps, whose insertion is indicated in our drawing. The newel of the stairway of mansion de la Tremoille was made of three blocks of stone from top to bottom and set on end and covered by sculptures, likewise receiving in recesses the ends of the steps.[2] The superposed blocks of that stone tree were connected together by strong pins of hard wood. Unnecessary to state that the cutting of such newels before setting must require a very remarkable skill and knowledge of drawing.

Note 2.p.313. Important fragments of this newel exist at t the Ecole des Beaux Arts.

Sometimes after the 14 th century, when one had only a very small area for developing internal screw stairs, he entirely suppressed the newel to leave more space for those ascending or descending. The steps were then simply superposed in a spiral, each having a round at the end near the centre to offer a hand-rail; in the place of the newel was a well-hole. Here (21) at A is the half plan of a screw stairs of that kind, at B its section on the line C D, and at C one of the steps in perspective, with the unseen surfaces of the lower bed indicated by dotted lines. It also occurs that in the interiors of

apartments and to communicate from one story to another, stairs were built receiving light from the halls, screw stairs enclosed partly or entirely by tracery. There exist two charming stairs of this kind, which date from the beginning of th the 13 th century, in the two halls of the second story of t the towers of Notre Dame of Paris. We do not think it necessary to give them here, for they have already been engraved se several tomes and are perfectly known. One of these screw stairs is enclosed by columns in the cathedral of Mentz, that d dates from the middle of the 13 th century; we give (22) half its plan and an entire revolution.[1] Aside from the circular wall that only ascends to the level A, the construction only consists of steps bearing the newel and the little columns of equal height, each supporting the outer end of a step. Nothing is more simple and more elegant than this little structure. Stairs of this kind are also seen in the upper part of the to towers of the cathedrals of Laon and of Rheims. These screw st irs rise in the middle of great pinnacles, that from the last story of the facade form at the four angles of the towers an open decoration for their entire height. The screw stairs of the cathedral of Rheims have in particular, that three steps are cut in a single course (the materials with which t this monument was erected are enormous), and that the outer e ends of these steps are relieved by blocks of stone set on e edge. Each block is then cut according to the prespective sketch, Fig. 23. Struts of stone B support the points A and then rest on the ends of the steps at C. In fact the newel D supports the entire load, and the stones B are only a series of p pillars forming an open enclosure. It also occurs that these screw stairs are half engaged in the wall, half open; thus w was arranged most of the internal stairs connecting two superposed rooms. The stairs of the gallery of church S. Maclou of Rouen (16 th century), that of the choir of the cathedral of Moulins (15 th century), furnish very pretty examples od this kind of screw stairs receiving light from interiirs.

Note 1.p.318. This stairs formerly ascended above the enclosure of the choir.

We have seen how the steps of screw stairs naturally form a rampant ceiling under the steps; now these steps are beveled or simply chamfered, or even left with square angles, thus gi-

giving as a ceiling the counterpart of the steps. But it occurred that one was sometimes compelled to establish straight or circular flights through massive constructions in castles and towers. The coverings of these flights then had to carry a considerable weight. If the flights were wide (as generally descents tc cellars in castles), the architects dared to cover t these stairs by rampant ceilings composed of a series of lintels, for fear of rupture. They what should they do? They turned a series of pointed arches A or round arches A′ beside e each other (24), but following the inclination of the steps a as indicated by the section C. These arches all had their springings at the same face; thew were all cut to the same curve. If the intrados of their imposts died at the face of the wall, the extrados reached G. These imposts were then equally seated, and the stonecutters or setters avoided the difficulties of cutting and setting rampant vaults, whose imposts take long to draw, occasion considerable removal of stone and require particular care in setting. If these flights through the constructions were narrow, if the architects possessed strong stone, they contented themselves by placing beside each other according to the inclination of the flights a series of lintels relieved by corbels at the sides (Fig. 24).elevation at D and section E). These very simple constructions produce a good effect and have a solid and resistant appearance; they perfectly indicate their destination and can be employed with inpunity under considerable loads. Vaults turned in offsets under great walls or masses do not have the inconvenience of causing the upper construction to slip, as may occur when rampant tunnel vaults are established under these loads. Sometimes in fl-flights covered by lintels, instead of simple corbels placed under each lintel, a wide continuous moulding projects squarely beneath the stones forming the covering as indicated in Fig. 25. Of a necessity of construction these architects have made here a motive of decoration, as everywhere.

ESCALIERS DE CHARPENTE ET DE MENUISERIE.

Stairways of Carpentry and Joinery.

Of wooden stairs preceding the 16 th century, there remain to us only very few fragments. The oldest are perhaps the two screw stairs of the S. Chapelle of Paris;[1] it is true that th these are masterpieces of joinery of the 13 th century. Yet t

the architects of the middle ages carried very far the art of arranging wooden stairs in buildings, and in that their subtlety must have come to their aid, for of all parts of the construction of edifices or of private houses, the stairs is that requiring most skill and study, especially as often happens in cities and even in the habitations of the lords in the middle ages, when space was lacking. Thus one can recognize in examining the interiors of castles and houses, the architects made wooden stairs with one, two or four newels, and double flights; they even went so far as to build screw stairs of wood turning about a pivoted post, so as to reach at once all the doors of the apartments of the upper stories. In his Theatre de l'Art du Charpentier, Mathurin Jousse (1627) has preserved for us some of those methods still used in his time.[2] "No one is ignorant," says the author,[3] "that among all the work of the c carpentry of the building, the stairs does not yield in convenience and utility to any other; being a passage, it is of common use and service for all chambers, stories and the e entire edifice; if it be useful, it is no less pleasing, but is also difficult in drawing sections aud assemblage, as well as for the variety found in them; for beside the ordinary ones common to all chambers of a building, there are some (although they are common), that still have such a peculiarity, that two persons of two different apartments or chambers maw ascend without seeing each other; thus a single one will perform the functions of two, and will be common without so being. Some are made in other ways, no less pleasing than the former; for being built on a pivot, they are easily turned, so that by a half turn, they close all the chambers of a house, and prevent passage to places to which they previously afforded it."

Note 1.p.320. A single one of these stairs is old, the second has been rebuilt exactly on the model of that existing at the moment when the work of restoration was undertaken.

Note 2.p.320. We have already stated many times, that the R Renaissance in France was scarcely more than a new dress by which architecture was covered; the constructor remained French until the middle of the 17 th century, retained and reproduced his old methods, much superior to those adopted from t that epoch till the end of the last century.

Note 3. p.320. Fig. 112. p. 171.

Before presenting some examples of stairs in carpentry or joinery, it is necessary to first indicate the elements composing these stairs. There are stairs with straight strings w with posts, stairs with newels, and screw stairs without newels and with spiral strings. In the wooden stairs of the middle ages the steps are always solid, attached to the strings by tenons and mortises.

Let (26) be a straight string with inner face shown at A a and section at B; each step will have a tenon C with tusk D, and will be slightly housed at E into the string. These steps will be beveled underneath and form a rampant ceiling. The s string will also carry the balusters G, tenoned and morttses out in the notches H. The ends of the step with its tenon is sketched at K. These steps being solid are usually cut from logs as indicated by the sketch L. Three saw cuts I divide each log of 1.6 ft. diameter into six triangular prisms, in each of which is formed a sted, so that the tread of each step may be in the heart wood, the tread of the step being th the part most worn. If there remains some part of the sap-wood on the surface, this is found at the rear of the tread which not subject to the friction of the feet. This method of making the steps of solid wood, the tread next the heart, further has the advantage of preventing the wood from cracking or warping, the saw cuts being made exactly in the direction of the cracks. This diagonal sawing of the steps loses none of the solid and resistant parts of the wood, the steps are all in the same conditions of hardness, and there remain at M good slabs that can be utilized elsewhere. One recognizes that the constructors have selected their wood with great care for the strings and steps, to avoid dislocations and the warping so injurious in works of that nature. Sometimes, but rarely, the steps are of walnut or chestnut.[1]

Note 1.p.322. Particularly in the centre of France.

These first principles of construction being stated, let us first examine a stairway in two flights witt steps at the landings, straight strings and angle posts; this is the simplest carpentry stairs, that constructed by the most natural means. Here at A, Fig. 27, is the plan of a stairs established on th this system; the first step is at B, one arrives at the first landing C, takes the second flight whose step is at D, ascends

of the landing E, which is at the level of the second story, and thus for each story. The scale of the plan is 1 : 100. Let us make a longitudinal section on a b at double size for clearness. Its four angle posts rise from the ground and are set on a stone coping. The first string also rests on that course and joins the post F into which is halved the landing step G, again supported by a timber attached by tenons and mortises, resting on the bracket H. Pass to the third flight that is entirely similar to the second, and which is represented in the section. The string is relieved below by the brace I and the tie K. The large ties are especially necessary to prevent swaying and thrusts, that do not fail to occur in stairs of this kind serving several stories; they stiffen the entire system of carpentry, especially if as drawn, the open panel is placed in the triangle formed by the post, string and that tie. The balusther of the railing are fixed in the strings, a and their hand-rails in the posts.

Let us now examine how are combined the joints of the strings with the posts, the landing steps, the beams of the landings, etc., Fig. 23; at A we have drawn in the same view the post, the landing step, the upper step and the starting step (this is the detail of the part L, Fig. 23); at B is drawn the post; at C the beam of the landing with its double tenon and its moulding at C′; at D the brace of the starting string, at E E′ the ending of the string, at F F′ the starting string with its tenon; at G the last step forming the landing step; at H′ the first starting step resting on the landing step with its tenon I entering the post; at K is part of the landing step seen in section between the two posts. This landing step, halved into the post and partly resting on the beam C, is strongly fastened at its junction by means of a bolt passed through the brace D. The posts are 7 ins. by 8 ins. deep in the direction of the flight. The brace D of the strings E E′, F F′, is not joined at the middle of the posts; these strings are 6 ins. thick and are flush with the outside of the posts (see plan). Observe the various joints made in the post traced in the perspective detail O; at N is the bracket designed to receive t the landing beam C; at P are the two mortises and housing of the joint of that beam; at R is the gain in which,rests the landing step with the hole S for the bolt; at T is the brace.

The perspective sketch Q shows us the landing step on the side of its gains entering those at R on the post. The last upper step is represented at U; the first starting step at V with i its tusk and tenon X; one sees at Y the hole for the passage of the bolt. This system of stairs vit straight flights and landings continued until the 17 th century; it was very stable, could not be deformed like most of our stairs, whose strings are only fastened to the landing steps and always end in bending. This is true carpentry in which all joints are visible and solid, and alone form the decoration. Further, nothing prevents covering the posts, stringr, ties and balustrades by carvings and paintings; then this is often done.

Screw stairs were built of wood as well as of stone. The o oldest were constructed in the same manner, i.e., the steps were solid, superposed and supported the newel. Double strings were made, that might have two flights, as we have said above, i.e.,(29) that entering indifferently by either door C or C′, one took either flight with its first step A. This was a means of giving entrance into rooms of the upper stories by doors opened over those at C, C′. The person entering by the door C could rejoin the one entering at C′, the two flights circling around each other. The two newels were connected by two strings B crossing each other. These stairs were very common during the middle ages and until the 17 th century, were convenient, and it is not explained why their use ceased. At one end the steps tapered or uniform, were connected with the two newels and the strings by tenon and mortise; at the other they were engaged in the masonry or rested on a strip of wood nailed along the half timber frame.

But frequently screw stairs of wood were entirely isolated, forming a work independent of the building. These stairs placed in communication two stories, and they were set in the corner of the room to communicated only with that above. This was rather a work of joinery than of carpentry, treated with care and frequently with great richness of mouldings and of carving. Yet the steps of those stairs of joinery remained solid until during the 15 th century, supported newels, and were connected at the centre by means of a round iron rod or bolt, that prevented them from moving. Each step had its vertical strut to which it was connected (30). These verticals were each of a

single fiece for each story, were fixed at bottom to the floor of carpentry and at the top to a circle also of carpentry. This formed a cylindrical enclosure or a prism with as many sides as there were steps in the horizontal projection. We g give at A the quarter plan of a stairs of this kind having 12 steps around its perimeter. The verticals are at B, and the newel rests on each step at C. The spaces E F give the overlapping of the steps on each other, the front of each step being F and the back at E. If we make an elevation of the quarter circumference of the stairs, we obtain the vertical projection G. There is seen at I the bolt that passes through the course of the newal belonging to each step. The ends of the steps appear at K and rest on a bracket notched into the vertical. The detail O gives the horizontal section of a vertical at one-tenth full size. At a is the tenon of the end of the s step indicated at a′ in the perspective sketch M; at b is the tenon at the end of the bracket, its tenon is indicated at b′ on the perspective sketch N; the back of the step being at e, the face of the next step above is at f. Each step resting on the rear of the one below bearing the tenon a, has no need of a tenon on the front, the more that these steps fully rest on the bracket J, furnished with a projection P intended to hol d their ends T. A gain R made in the vertical R also further permits the step to be fixed into that verticala The perspective sketch M shows the front of the step coved at S, the end being visible outside at T, the two gains allowing the verticals to pass and gained at Q, the boxing of the end of the bracket u under the end of the taper of the back at V, made for space a and lightness. According to this principle are constructed t the two stairs of the sanctuary of the S. Chapelle of the palace (13 th century), and some stairs of towers, notably that of the tower S. Romain at Rouen (15 th century). Two of the verticals cut off at 6.6 ft. from the ground and resting on a cross-piece attached to the adjacent posts, permit the entrance into these enclosures and to take the stairs. It is clear that one could decorate the verticals by capitals and mouldings, and that the brackets could be very rich, and the ends of the steps be moulded. Except the axial bolt, these stairs were built and maintained without the aid of iron work; this was a work of joinery, without the use of other means

than those suited to this art, so ingenious when it adhered to the methods and procedures that belonged to it.

About the beginning of the 15 th century, in the construction of screw stairs in carpentry and joinery, men ceased to c cause each step to carry a part of the newel. That was erected in a single piece, and the steps were joined to it by a series of mortises cut one above another according to the flight. This was done at the same epoch for screw stairs in stone, as we have seen above. Just as the stone newels were carved, as they were cut wit continuous lines, the corbels were arranged to receive the small ends of the steps, similarly were made newels in carpentry. We saw demolished the old college of Montaigne at Paris and a pretty screw stairs in joinery, whose n newel was a long timber 39 to 43. ft. in height, and very skilfully worked like a column with spiral ribs, corbels under the steps and a hand-rail. We give (31) the arrangement of these carpentry newels at the junction of the steps. At A is seen the mortises of each step with the shoulder below to relieve the span; at C is the hand-rail cut in the solid like the corbels; its profile is traced at D, cut perpendicular to its inclination, the profile of the cornice with the corbels is traced at E.

Before ending this Article, let us say a word on those pivoted stairs of which Mathurin Jousse speaks, and that must have been employed in buildings where night surprises were to be feared, in manors and keeps. These stairs were established in a round tower, in a cylinder of masonry pierced by doors at the heights of the stories, that one desired to reach. The stairs was independent of the masonry, and was composed of a an axis or pivoted newel supporting the entire system of the carpentry. The plan of that stairs is shown at A and its section at B. At each story to which it was necessary to afford access, was arranged a landing C in the masonry. We arsuem all the doors to be opened over that of D of the ground story. T The first step is at E; from E to F the steps are fixed and independent of the carpentrw newel mounted on a lower iron pivot G, and maintained at the top of the screw in a circle cut out of two horizontal pieces of wood. The first step is fixed to the newel at H; it is strongly supported with the three succeeding ones by braces I. From that supported step H begins a

spiral string fastened to the ends of the steps, and supporting a cylindrical enclosure of wood pierced by doors opposite the openings D in the masonry. Above the third step (starting from H), the other steps up to the top of the screw are only supported by the little braces K, shorter than at I, so as to facilitate the headroom. Thus all the steps, the string and the cylindrical enclosure rest on the pivoted axis O. When it is desired to close at one turn all the doors of the stories, it suffices to turn the cylinder a quarter turn on its axis. These doorways are then covered; between the steps F and H remains an interval, and persons that have ascended it to enter the apartments, finding a wall opposite the openings found in the cylinder, and are unable to guess the location of the actual doorways corresponding to those openings, when the stairs is returned to place. A simple bolt shot by the occupants on one of the landings O prevents rotation of the screw. There was a means of avoiding intruders. We have sometimes found c cylindrical enclosures of masonry in castles with doors at e each story, without any trace of the stairs of stone or wood; it is probable that these enclosures contained stairs of this kind, and we believe this invention to be very ancient; it is certain that it could be utilized, when it is necessary to reach several points of the circumference of a circle at the same level. We shall have occasion to speak of these stairs in Arts. Chateau, Maison, Manoir, Palais.

ESCHIF. Bay. Turret.

A little flanking fortification made to defend the approaches to a gate or to enfilade a trench, when the enclosures of cities consisted of a simple walla Frequently these bays were wooden structures,temporary if time and resources are wanting for erecting towers. Lebeuf, in his Histoire de la ville d'Auxerre,[1] says that at the end of the 14 th century, there were erected several bays."They removed at certain places and rebuilt at others; then was given the form of actual towers to what was previously only a simple bay; in brief, the city was fortified in proportion to the entrance tax granted by kings Charles V and VI." After a siege during which the walls were damaged and their towers dismantled, bays (1) were placed on the curtains to command the exteriors, during which were exe-

executed the repairs judged to be necessary. [1]

Note 1.p.331. Mem. conc. l'hist. civ. et eccles. d'Auxerre, b: abbe Lebeuf, pub. by Cnelle and Quantin. Auxerre. 1845. Vol. III. p. 279.

Note x. p. 332. Of the old fortifications of Blois. Civil. orbis terrorum. 1574.

ESCOPERCHE. Scaffold Pole. Extension.

A pole or timber set vertically to support the putlogs of a mason's scaffold (Art. Ecnafaud). It is also a timber with a putlog at its upper end and attached at the top of a crane to increase its height and give it greater reach.

ESTACHES. A Retreat or an Assemblage.

Used in the plural and during the middle ages signified an assemblage of pious persons. (Art. Cloture).

ETAT. Shore. Strut.

A straight and stiff timber employed to support a structure that threatens to fall. One cannot doubt that after the 13 th century architects were very skilful in the art of shoring st-structurer, either to strengthen them by means of underpinning, or to modify the previous arrangements. The facility with which the decided seems prodigious, at the moment when Gothic a architecture appeared, to change and partly rebuild scarcely completed buildings in order to put them in harmony with the new methods, which rapidly advanced, and cannot only be compared to what we see done in our time.

Since the architects of that epoch of the middle ages worked on generally light structures, in which one never finds an excess of strength, it was necessary that their procedures in shoring should be very perfect, for those heavy structures, kept in equilibrium by forces acting in opposed directions, could not be maintained when a part was removed, and it was to be feared in certain cases, that the shores should not have sufficient force to thrust sufficiently and destroy the e equilibrium of structores, that it was claimed to preserve. On seeing the nature of the underpinnings executed by the constructors of the middle ages, one cannot doubt that they very frequently employed struts, a sort of shore that supports ver-

vertically without exerting either thrust or pressure. Thus the underpinnings made about the middle of the 13 th century in the choir of S. Denis, and those much bolder made at the end of the century in the choir of the cathedral of Beauvais: about the the beginning of the 14 th century in the side aisles of the choir of Notre Dame of Paris near the crossing, and in the cathedrals of Nevers and of Meaux, indicate boldness a and singular skill. It would be impossible for us to furnish examples of all the cases of shoring that might be presented: the skill, knowledge and experience of the constructor can o only prescribe to him the system of shoring required by each particular case. We shall refrain from prescribing methods g good in one case and bad in another: we shall content ourselves by indicating general principles. Thus when one shores a particular part of an edifice, he should not think only of p preventing the effects of a dangerous movement produced in t the structure, but it is necessary to make such arrangements,, that the part to be replaced being removed, the loads or thrusts cannot act in the sense contrary to the effect produced; it is essential for all shoring to be neutral.

For example, if we rebuild the piers of a nave in which the effect is produced, as indicated in Fig. 1, shoring A B is e excellent to stop the bending of the piers C D, but will be dangerous if we remove the column D E to replace it by another, for the loads acting from C to E cause the shore A B to pivot on its base G and to firce the arch I K to I'K, which will produce a dislocation of the entire structure and a settlement of the upper parts. In this case one must be very c careful to do nothing that can charge the bending between B and F. One must be contented with placing a frame of shores L M, Fig. 1 bis, and nothing at each side of the pier to be removed from N O, the lateral arches being round: then one can remove the pier and rebuilt it vertically while transferring its base to R'. When it is necessary to shore a wall behind which are built vaults, to rebuild it entirely or in part, Fig. 2, the first operation to be done is to place centers u under the arches A B of the vault; as for setting the external shores, their heads should bear exactly above the point of support where the rupture is particularly apparent. If the rup-rupture of the wall or buttress is at C, the head of the shore

should bear at D, and to receive that head, it is prudent to first insert in the masonry a good block of hard stone, so t that these may not rest on that head or crumbling or weakened surface, or without bonding to the wall. Let -, Fig. 2 bis, be the old surface, a strong block B of hard stone is first inserted to project from the face, and placing under it a good wedge of heart of oak, below it is set the head of the shore D. It is unnecessary to state that the architect must pay the greatest attention in all cases to the ground or sill on which rests the base receiving the foot of the shore; too frequently one neglects to be sure of the resistant quality of these points of support, it results that the shores sink their sills under the load. These sills must be placed on uniform ground; they should be large and thick, well wedged at the desired inclination, and set in good plaster underneath. At Paris, t the custom in building very large structures, of underpinning very high and very heavy houses, causes shoring generally with skill and stability, but in the provinces our architects and contractors do not devote the required attention and care, t in these delicate operations.

The best wood for making shores is evidently spruce, because it is straight and extremely stiff, it is difficult to make good shores of oak, generally of moderate length, often crooked and heavy, and consequently more difficult to raise. However in shoring, oak must be preferred for sills, wedges and the caps of shores, because its wood does not crush under the load like that of fir. Poplar is employed in some parts of France for shores, but is much too flexible timber; it bends and twists in all directions under the load, however well it may be braced.

To obtain a simple shoring of great strength, one should never trust to a single spruce timber, however large and sound it may be; it is necessary to double the shore, i.e., to place two shores in the same plane perpendicular to the face of the wall or pier to be shored, and to brace between these two shores. A powerful shore is that in Fig. 3, and two or th- three timbers set in the same plane must not be parallel; they must form a trangle or a portion of a triangle, because a triangle cannot be deformed; being braced, the timbers not b being parallel present a homogeneous whole, like an enormous

brace; while if parallel, they can bend under the load, as demonstrated in Fig. 3 bis, however well braced. It is not indifferent whether the shores are closer at top or bottom. If (Fig. 3) a wall A B presents an abrupt bend at C, the shores should be set as indicated by the sketch D, i.e., the two timbers w will be farther apart at their feet than their tops, for the bending being at C, it is necessary to support and abut the upper part k, and it would be dangerous tc produce a pressure from the exterior to the interior at E, which would infallibly occur if the large shore G H received the load; then one would risk increasing the rupture of the masonry above the bend. But if a wall is bent in a uniform manner, as indicated by the s sketch F, the two shores should be more distant at their tops than their base, for if the masonry rests on the upper timber G′H′, and this timber receives the load, all the load and the thrust from inside to outside will be transferred to the second timber I K; it is then necessary for this not only to support, but also to abut by its inclination the bending, that would tend to increase at K.

It it is necessary to place double or even triple timbers i on a plane perpendicular to the wall to be shored, when one desires to obtain great strength, and to prevent the timbers from bending in their plane, it is also necessary to prevent them from bending out of the proper plane and warping; to do this it is well to place groups of shores as indicated by F Fig. 4 in plan and perspective; these two non-parallel groups must be made stable by braces. Thus by arrangement of the shores, the system will only form a stable and very resistant body represented by the sketch O, a sort of buttress in a single piece, beiug unable to slip or be deformed. This sort of shores is very good to maintain a retaining wall pushed by earth, and that threatens to yield to a very strong pressure.

Nothing is more satisfactory to the eye than shoring well combined and executed. Every architect that loves his art should not only indicate the arrangement of the shoring, he must also supervise very carefully that the carpenter employs timbers proportioned in strength to their purposes; that these be clear and properly cut as required; that the braces be gained and cut to length, neither too thick nor too thin; that the bases present under the feet of the shores a plane and

smooth surface, cut as far as possible to keep the shores in their plane; that the wedges are properly cut and are of good wood, the spikes or nails that hold them being driven straight; that the masonry under the bases be made with care, regularly extending on each side the breadth of the base.

There are circumstances in which one can neither place props, ordinary shores or struts, for example, where it is necessary to remove a pier underneath, because the lower courses are c cracked or seriously injured. Let Fig. 5 be a cylindrical pier supporting arches in all directions, four transverse and four diagonal arches; this pier supports two or three stories and other piers with vaults; it is impossible either to shore it or to establish props. The eight arches may have centerings, but that will not prevent the weight of the upper pier from acting on the lower one. The lower courses of that pier are crushed. We shall establish an oak frame of large timbers, t that will be as indicated by sketch B in perspective and B′ in plan, with joints, tenons and mortises, bolts b and keys e, which permit drawing the fram strongly against the cylinder. This frame will enclose the cylindrical pier beneath the astragal of the capital; (see sketch D); we shall fill with good plaster the entire interwal between the top of the frame C and the corners of the abacus E of the capital. Under the angles of the frame we shall place eight struts G, also indicated at G′ in sketch B, sufficiently inclined to allow us to pass in the courses that replace H. But under the capital exists one or two drums intact, that are to be preserved. We h have made four iron straps according to sketch F, of the height of the drums to be retained; these straps are to be fixed with square head screws and gained on the frame; their ends T will catch the lower bed of the drum to be retained. This being done, we can remove the course K from the mass with the point, then remove the lower drums and replace them with new stones. If the entire lower pier be crushed, if its capital is broken, if the imposts of the arches are bad, we shall proceed in the same manner for the capital of the column above it, Fig. 6; we pass the eight struts through the eight compartments of the vaults (see plan M) at P, and we then have our iron straps extend to the defective point, as at O, and we re-remove all the lower part and rebuild and underpin; removing

the vaults (once the upper pier is shored), we first rebuild the lower pier with its imposts and arches, and that being c completed, the struts and frame are removed, resting the vaults on centerings without trouble.

If one can trust the solidity of the capitals or if the piers have none, if these capitals themselves are to be replaced because they are broken, one can have recourse to frames with iron caps.

For example, it occurs that the piers (7) receiving two archivolts A, two diagonal arches B and one transverse arch C, a also at D the load of the upper pier supporting the high vaults, are too small, are broken, or are crushed as far as the tops of the imposts of the arches. In this case, to rebuild these piers, their capitals and their imposts, it is not only necessary to shore the upper construction; it is also essential that these shores permit the passing of great blocks between them, and to bring them to their places without too much difficulty, set them properly and fasten them well. Shoring is nothing but to shore in the manner to allow rebuilding between the struts is frequently the problem difficult to solve.

Then let E′ be the elevation of the pier E; not only is that pier bad, but the imposts of the arches are broken as far as F. Above that level the masonry is thicker and is retained; it is necessary to remove the entire construction between F and G. First we place a center under the transverse arch C, t two centers under the two diagonal arches B, then in Fig. 7 b bis we place under the two archivolts A two shores arranged as our sketch indicates; at H H we place two ordinary struts to maintain well the front of the pier, we remove the first voussoirs of the archivolts from I to K; which will permit us to make two holes L through the masonry retained in order to pass two strong iron beams M, each composed of four bars banded together, with strength proportioned to the load. These two beams rest on the frame N supporting oak caps O. In plan this shoring presents the horizontal projection drawn at P; the pier is E″, the centres are C′B′B′, the shores of the archivolts are A′, the frames are N′ with their caps O′. The iron beams are shown by two black lines. The shores of the front opposed to the thrusts are projected at H′. These must be combined and placed, so that at the height of the capitals, abacuses a

and imposts, courses that we assume in two blocks for each, the space S T between the shores A′ and the feet of the shores N′ being wide enough to pass these blocks. It is also necessary that the cap of the rear frame clears the transverse arch C, to not interfere with replacing the first voussoirs of that arch, if needed. The courses resting thereon must be strongly wedged under the masonry V. The voussoirs being well set and fixed above the imposts, the two iron beams L are removed, a and the small holes left are filled. The frames and iron bars being first removed, the shores of the archivolts are taken away, and only after the mortar is fully dried, the two struts H. It is understood that the order in which the shores must be removed is not an indifferent matter, for if these shores fulfil their functions well (and in such a case, it is necessary for them to do this, since they alone bear all the load), when the removals beneath are completed, however well this is done, it is always the shores that support. From the moment that these are loosened, the new construction assumes the load; it is then important:- 1, that they only take the load gradually; 2, that the loads act equally and vertically on t them. Frequently a shore is loosened too soon or too rapidly, and causes the breaking of the best established substructures. The important thing is to loosen together the opposite shores, as for example, the two shores A of the archivolts. Further, it is with shores as with many other matters that belong to t the art of construction; so many examples, just as many special cases; consequently as many procedures applicable to these particular cases. One can only establish the general principles and indicate some of the thousand applications presenting themselves daily. We will state that the first care of an architect, that desires to shore his structures, is to know exactly how they are to be made, what were the procedures employed by the constructors, what were their habits, their machines, their d defects and their ordinary qualities, for one must in advance guard against these defects anf profit by these qualities.

The edifices of the Gothic period being elastic and always equilibrated, it occurs that these properties can serve you, if you know them accurately, or they may cause accidents if you do not take them into account. We have seen underpinned structures, that because of their height and enormous weight

could not be shored, for example, towers placed on four piers, and that by very simple and inexpensive means, because the constructors directing this rebuilding knew how to profit by the flexibility of these structures, and utilized the conditions of equilibrium. But when one underpins, by the extraordinary means employed it costs more than the entire construction of the part of the monument to be strengthened, that is no longer art. let us again state that every building shored to be repaired requires constant supervision. The architect must observe the least symptoms manifested; the opening of a hole, a cr crack in a stone, are always the indication of a movement, t that however weak it may be, must be ascertained, and the architect should allow himself no rest, till he has recognized the cause to remedy it. A wedge properly placed, a strut set in time, often prevent the most serious accidents. if movements appear, it is at least necessary that they come to the a aid of the architect, so to speak, that they enter into his general system of support. It is the same for those very serious cases, where the architect must produce these movements, like a skilful physician, to treat a local information, to dr draw the disease to a different part of the body. One may say that all shoring of structures consists in preventing an evil; but in Gothic edifices, it is not sufficient to prevent, it is necessary to avoid that evil; if a point weakens, all the vertical or oblique loads rest on that weak part; it is then necessary to reestablish those laws of equilibrium, and for that it is not only necessary to support and restore the part injured, but it essential to transfer the excessive loads elsewhere; otherwise, the repairs being made, equilibrium will always be broken, and the evil remedied at one point will soon be produced elsewhere.

ETANCHON. Strut. Shore. Stanchion.

A timber set vertically under a structure to stop crushing. The strut only resists vertically; it is generally short; when it exceeds a length of 6.6 ft. to 9.8 ft, it generally takes the name of shore.

During the middle ages by the same word was also designated the little posts that the miners set beneath undermined walls to prevent them from falling on the workers. When it was desired to cause the walls to fall, fire was set to the struts.

(Arts. Architecture Militaire; Siege).

ETAYEMENT. Shoring.

Also written etaiement, the action of shoring or combination of shores. (Art. Etai).

ETONNE. Stunned.

Men say: this iron or this stone is stunned, this signifies that the iron has suffered a shock or test, that not causing an immediate rupture, has however predisdosed the metal to b break easily; that the stone has likewise disintegrated by a physical force or cracked by a shock, and that it is also found in bad conditions for resistance. An unskilful smith may shock his iron if he gives it a false stroke of the hammer, when it commences to grow cold, the careless stonecutter shocks his block of stone in cutting it, for example, if he breaks o off a piece without taking time to remove the stone gradually. It stuns the surfaces to use a bush hammer, i.e., it disposes them to disintegrate more easily under the action of atmospheric agents. The architects of the middle ages, who did not desire hollows, took care to profile them in such manner, that the stonecutter was not led to stun the stone. Thus for example, the horizontal sections of piers composed of clusters of little columns, those of the moulded arches always in the reentrant angles having hollows or flat fillets, that stop the tool in time to prevent stunning the stone. If we profile a pier according to sketch A, Fig. 1, it is certain that to obtain the sharp angles B, the stonecutter will stun his block; but if we trace the section C, reserving the flat fillets D in these reentrant angles, we shall avoid this great inconvenience; although the stone is hollowed, it will retain its strength. (Art. Profil).

ETRESILLON. Strut.

A timber designed to prevent two parts of the structure from approaching each other. When a wall pierced by openings breaks or is dislocated, the first operation to perform is to strut the ofenings. (1). A are struts set between the bambs of the openings on vertical planks B.

In masonry the architects of the middle ages frequently ad-

adopted struts as a means of permanent construction, like the flying buttress, that may well pass for permanent struts. The south porch of the cathedral of Puy-en-Velay, built about 1150, presents a very singular example of the use of struts fixed in the masonry. This porch opens with a great archivolt possessing a concentric isolated arch (2), absolutely useless, and a pure decoration maintained by means of three isolated pilasters, intended to prevent its rising or its deviation from t the vertical plane. The section A made through the middle of the archivolt, indicates at B the lower detached arch and its little axial pilaster C. With more reason circular rose windows inscribed within curvilinear triangles, are strutted in the two lower angles by little columns, that prevent the voussoirs from leaving the curve (3). This arrangement is seen to be adopted to maintain the voussoirs of the rose window opened over the lateral doorways of the facade of the cathedrad of Amiens. In fact the great rose windows of our French churches dating from the middle of the 13 th century, only consist of a system of stone struts. (Art. Rose).

ETUVE. Baths.

No one is so ignorant of the care with which the Romans established public and private baths. The ancients regarded hot and cold baths not only as one of the best means of preserving health; but also this was for them a custom, a pleasure. Our clubsin the great cities, and our cafes in small localities, are the only establishments today, that can give us the idea of what were the baths among the Romans. Men went to the baths to bathe, but still more to assemble, to know the news of the day, to speak of their business or pleasures. These habits th that belong to an advanced civilization must evidently be changed when the barbarians extended in the West. Yet if we believe Tacitus, the Germans rose late, bathed most frequeutly in warm water, after which they took some food.[1] Charlemagne seems to have adopted entirely in that respect the habits of the Romans. Eginhart [2] says that this prince greatly loved baths in thermal waters. "With a passion for swimming," he a adds, "Charlemagne became so skilful in it, that no one could be compared to him. For this he had built a palace at Aix-la-Chapelle, and he lived there constantly during t e last years of

his life, until his death. He invited to bathe with him, not only his sons, but also his friends, the great men of his court, and sometimes even his soldiers and his lifeguards, so that frequently a hundred persons or more bathed at a time." It is not doubtful that Charlemagne in this as in many other things, only resumed the habits of the Romans of antiquity.

Note 1.p.347. Latin note.

Note 2.p.347. Vita Karoli imperator. Section 12.

Note 1.p.348. Roman de la Rose, verse 11,1[illegible] et seq.

Note 2.p.348. The same. Verse 17, 85, et seq.

No longer are found traces of these great arrangements from the 10 th century, and the baths after the 12 th century are only bathrooms, i.e., establishments similar to those that we still possess today, except that the bathtubs were of wood, marble or stone, and the bathrooms were probably less inconvenient than ours. It was also the custom during the 13 th century to bathe in company, sometimes even in the same tub. (Old (Old French poem).

And all being well close, a good fire was kindled. (Old French poem).

It appears that then (in the 13 th century) there were bath roomsin the castles, but there existed much frequentel public baths in the cities. Indeed many old cities have retained their street of baths. In his excellent Histoire des Provins by M. Bourguelot [1] we read this passage:-- "As for baths, the f first mention that we find of them exists in a note of May, 1236, according to which Raoul de Brezelle, knight, gave to the poor of the hospital of Provins 12 deniers of rent, that he had received annually for five rooms located behind the hospital between the mint and the baths. It is probable that these baths, which occupied the location where one still sees the graceful mansion of the lions, being the only ones originally in Provins, that their age had given them the name of the old baths. They fell into ruin in 1356. Louis-le-Hutin established new ones in 1309 "because of the wealth of the people," says Voissant; [1] but the wealth was not of long duration, for we see sometime later "the rent of the baths diminishes in a sensible manner." [2]

Note 1. p. 348. Vol. I. p. 277, 1839.

Note 1.p.349. "In 1309 the baths were paved with stone from

Paris, and equipped with furnace, boilers and bathtubs."

Note 2.p.349. In 1311 the new baths rented for 240 livres; in 1315 at 100; in 1320 at 60; in 1325 at 95 livres.

These baths consisted only of rooms more or less spacious, and in which were placed tubs filled with warm water by means of pipes, as still practised today. In palaces bathrsoms were o often very richly decorated. Sauval [3] relates that at mansion S. Pol and mansion of Petit-Muce, king Charles V had caused to be arranged for the queen bathrooms paved with lias stone, "closed by iron lattice doors, and surrounded by wainscot of Irish wood; the tubs were of the same wood, ornamented all around by gilded bosses, and fastened by rings attached by n nails of gilt copper."

Note 3.p.349. Hist. et Antiq. de la ville de Paris. Vol. II. p. 280.

After the 14 th century, the same author states elsewhere,[4] "our kings built baths at the point of the island (of the palace),[5] and for these caused to be built a structure named t the house of the baths, as much for them and their children, as for the princes and the other great lords lodged with them; for at that time there were not only such in all palaces and great mansions, but even in some streets of Paris, expressly intended for them; from which it comes that some still retain this name of Rue des Etuves. As for the baths of this island, they were were given by Henry II to the workmen of the mint, at the mill that he caused to be built at that place, but which was destroyed when the Pont-Neuf was undertaken."

Note 4. The same. Vol. I. p. 99.

Note 5. Toward the terrace of the Pont-Neuf.

In these private baths were washtubs, that served as bathtubs, and that were placed in a room when one desired to bathe; that was termed bringing the bath." He sometimes brought the baths and heated the baths." Even sometimes meals were taken in the baths; "sometimes going to the bath, before which a fine supper was laid and served in haste."[6] And elsewhere; "One day among others, Madame had wished to bathe herself, and she caused the bathtub to be brought to the bathroom to be heated in her mansion."[1] A great number of vignettes of manuscripts of the 14 th and 15 th centuries show us personages taking br baths in a sort of wooden washtubs placed in a chamber, Every-

one knows the tale of the washtub, that dates from the 12 th century. Of all preceding citations, and to which we could add many others, if we did not fear to be too lengthy, one may c conclude here; that during the middle ages the use of baths, as they are taken today, was very extensive; that there existed public bathing establishments, in which were found baths and all relating to the toilet; that men ate there and even passed the night; that in castles and great mansions there were halls intended for the baths, nearly always in the vicinity of bedrooms; that the use of baths during the 16 th and 17 th centuries was much less extensive than it was before t that epoch, and was almost exclusively by the elevated classes; that these public establishments during the middle ages did n not present particular arrangements, only consisting of chambers in which were placed the tubs.

Note 2.p.350. See the extract given in Recueil de fabliaux des XII et XIII Siecles. Vol. III. p. 135.

Note 1.p.350. Lo Peche de l'onneou.(cent nouvelles nouvelles).

EVANGELISTES. Evangelists.

The four evangelists, S. Luke, S. Matthew, S. John and S. Mark, from the first centuries of the middle ages are represented either under the form of clothed men holding a book, or by some symbolical figures; S. Luke by the ox; S. Matthew by the man; S. John by the eagle; S. Mark by the lion. Sometimes the personnage and the symbol are combined, and even the evangelists have the bodies of men with heads of the ox, man, eagle or lion. In Art. Animaux we have given examples of the symbolical figures applied to the evangelists, and in Art. Eglise personified, one can see the New Law seated on a beast with four heads and four feet appertaining to the four symbols of the evangelists.

The sculptors and painters of the middle ages have also represented the four evangelists seated, or mounted on the shoulders of the four great prophets od the Old Testament. At the North portal of the cathedral of Bamberg, beautiful sculptures of the 12 th century show us the four evangelists so placed. (1). At Bamberg the evangelist holds the roll; he is mounted on the shoulders of the prophet to whom the artist has given the pose of an acrobat; the prophet turns his face toward the

evangelist; the latter has the halo. A dove (the Holy Spirit) is placed on the capital and bears a scroll in its beak. The glass of the southern window of the cathedral of Chartres has preserved the same subject for us in painting, but at Chartres the evangelists are seated on the shoulders of the prophets with legs at each side. In that glass S. Jerome supports S. Luke; Isaiah S. Matthew; Ezekiel S. John; Daniel S. Mark."The place," says M. Didron, "that these attributes and evangelests should occupy is this in an ascending line from bottom to top; the ox, lion, eagle and angel (man).[2] In the angles of a square as one frequently finds them, the attributes of the evangelists must always be placed in the hierarchical order; at the top the angel is at the right and the eagle at the left of Christ; below the lion is on the right and the ox beneath the eagle. When this order is not followed, it is an error. Still men have not always been in accord, neither on the place to mive them, nor on the special application to be made of each evangelist." Since the 12 th century in western monuments, the order that we give is followed without exception, in the application of the symbols for each of the evangelists.

Note 1. p. Mon. d.icon. chret., grec et latine, with introd- and notes, by M. Didron; translated from Byzantine manuscript, Guide de la peintury, by Dr. Paul Durand. Imt. roy. 1845.

Note 2.p.352. These four figures are winged. In Iconographie grecoue they have four wings, but in the sculptures of the middle ages in France they have but two.

EVANGILE. Gospels. Evangels.

A book containing the four gospels. In sculptures and paintings of the middle ages from the 11 th century, the book of the gospels is placed in the hands of the Christ-man in the form of an open or closed book; most frequently closed after the 13 th century. In the representations of altars the book of the gospels is placed on the table and is closed.

EVECHE. Episcopal Palace.

Episcopal or archiepiscopal palaces nowise differ from the urban habitations of lords in the middle ages. They have their great hall (hall of the synod), their open porticos and vast lodgings; nearly always they retain the marks of the feudal

residence, i.e., they are fortified externally, furnished with battlements and towers. (Arts. Palais, Salle, Tour). There now remain to us in France few old palaces of bishops or archbishops. Yet we shall mention here the archiepiscopal palace of Narbonne, 14 th century (now city hall and museum); the episcopal palaces of Laon, 13 th century (now palace of justice), of Meaux (substructure of chapel of 12 th century), of Auxerre, 12 th and 13 th centuries (now prefecture), the archiepiscopal palaces of Rouen (remains from 13 th, 14 th and 15 th centuries), of Sens (hall of the 13 th century), of Rheims (remains from 13 th and 15 th centuries); the episcopal palaces of Evreux (15 th century), of Lucon (15 th century), of Beauvais, 12 th and 13 th centuries, (now palace of justice), of Soissons (remains from 13 th and 16 th centuries).

EVIER. Waste Pipe.

Discharge of dirty water. In the offices of castles are nearly always found traces of waste pipes intended to discharge t the dirty water outside, that has served for washing vessels. These waste pipes consist of a stone cut in form of a basin w with a hole at the bottom and placed in a recess of the wall. The waste hole of the basin corresponds to a stone duct made in the thickness of the wall or forming a projection outside. Thus is arranged the waste pipe still to be seen in the castle of Verteuil (1), the basin being placed in the second story. Other waste pipes cast water directly outside by a gargoyle placed directly below the basin. Frequently these wastes are arranged in the opening of a window. M. Parker, in his Domestic Architecture of England, has given some of these wastes, arranged with special care. [1]

Note 1.p.353. This drawing was furnished to us by M. Alaux, architect at Bordeaux.

Note 1.p.354. See Some Account of Dom. Arch. in England. Vol-I. p. 129, 130.

EXTRADOS. Extrados.

Back of an arch or vault. Every masonry arch or form of jointing has its intrados anf its extrador. For an arch or section of a vault I, the inner surface A B of the voussoirs is the intrados, the exterior C D is the extrados. (Art. Construction

FABLIAUX. Fables. Tales.

We shall not undertake here to explain how and at what epoch fables brought from the East and Greece entered into the poetry of the middle ages, the more so that very good works exist on that subject; [2] We shall only state that about the beginning of the 12 th century, there are found on religious and c civil buildings sculptured representations of some fables attributed to Esop, and which from that epoch were very popular in France. Alexander Neckam, whose birth seems to date back to the year 1157, and who studied and taught letters at Paris, made a collection of fables entitled Novus Aesopus (New Esop), in which we may indeed find many of Esop's fables restored in Latin for the use of schools. [3] Neckam probably merely gave a literary form suited to the taste of his tome, to fables k known to all and many times reproduced in sculpture and painting. The first fable in this collection is entitled, De Lupus et Grue. (The Wolf and Crane). And indeed this fable is one of those most frequently found in the edifices of the 12 th and beginning of the 13 th centuries.

On the portal of the cathedral of Autun, 1130 to 1140, exists a cipital that reproduces that well known fable (1). But after the 13 th century, scupture and painting often took fables as secondary subjects on the portals of churches, principally of cathedrals and on civil edifices: the artists decorated by t them the capitals, corbels and panels. In the 15 th century, fables were singularly numerous and almost all sarcastic, invented and arranged by the troubadours, of the 13 th and 14 th centuries, and furnished to the plastic arts an inexhaustible collection of subjects, that we see represented in stone and wood, in the sacred place as well as in the house of the citizen. Fifteen years since, an author well versed in the knowledge of our old French poetry wrote thus;-- [1] "To speak only of the troubadours, authors of fables, who are especially reproached for the cynicism with which they treat the most respectable persons, ecclesiastics anf women. But do not forget, that there was then neither press, platform or theatre. Yet there existed, as will always exist, power ridiculed and abused. Society is unfortunately so made, that there is necessary a sort of escape or vent for popular discontent; the troubadours, mockers and satirists, were a necessity, the need of

that unhealthy and corrupt society. Their too lively satires, even frequently coarse for our refined ears, did not seem such to their contemporaries, since the wise and chaste S. Louis listened to those satires, was amused by them and rewarded t their authors, for example, Rutebeuf, one of the least reserv-ed of those old poets. And further, those satires against the monks, for example, had they slight motives? On the contrary, who does not understand the anger expressed by all authors of the 12 th and 13 th centuries, who saw their own lords, even the kings of their country, leave it, abandon their positions and families, expose themselves to all fatigues, chances and dangers, for the sake of a religion, whose priests, heirs of the fortunes and lands of the crusaders, lived in France in the midst of abundance, luxury and often debauchery? And in our days, have we not seen worse than fables for repressing abuses less shocking than those?" Fables belong to our country. Nowhere in Europe during the 12 th and 13 th centuries were not made those tales, poems, romances, lively, clear and caustic, light in form, profound in observation of the human heart. Germany wrote the Nibelungen, a sort of heroic and sentimental poem in which the personages act and speak outside the domain of reality. Italy tended toward the tragic and mystic poetrw, of which Dante has remained the most complete expression. Spain recited the Romancero, energetic in thought, concise in f form, in which the railing is bitter, envenomed, breathing p patient vengeance, in which the most tender sentiments retained the asperity of the wild fruit. This people of France, t temperate like its climate, alone in the midst of the middle ages filled with massacres, misery, abuses and struggles, retained its good humor; it bites without wounding, corrects without pedantry, the tragic burkin provokes a smile, bitter satire seems sad to it. It speaks and rails, but it brings in t the light turn of its fables, romances, jesting songs, that positive spirit of inflexible logic, that we have seen it develop in the plastic arts, he seems to skim over everything, but however light its impression, this is ineffaceable. To u understand the arts of the middle ages in France, it is necessary to know the literary works of our troubadours of the 12 th and 13 th centuries, of whom Rabelais and La Fontaine are the last descendants. To dream in sporting, to sound the most

concealed recesses of the human heart, and the most delicate in a phrase, to unveil them by a jest, leaving the mind to divine what is said or does not appear, there is all the talent of our old authors and old artists, so poorly known. What is finer than the prologue of the romance of Renard? In some verses the author shows us the turn of his mind, disposed to jest a little at everybody, with a fund of observation, very j just and of practical philosophy.

Note 1.p.See article on the Poesie du moyen age, by M. Viollet-le-Duc Sr. Annales archaeologiques. Vol. 2. p. 281. pub. by M. Didron.

God drives forth Adam and Eve from the terrestrial paradise. (Old French poem).

This is clever and lively, like the fable of La Fontaine, the Creator who takes pity on those he has just punished, the simplicity of Adam who returns the sheep to their fold, the indiscreet ambition of Eve, the intervention of the man that reestablishes good order by the new effort, acts that denote the thoughts, no talks nor reproaches, that is the world that goes on well or badly, but which goes on always, and the spectators who look on, observe and laugh. However naive it is, this is never so, never requires from our troubadours those d developments of violent passion, for passion makes them smil e like all exaggerations; if they express a tender sentiment, t this is done in two words, they have the modesty of the heart, if they do not always have the correct word. In the most tragic situations, the personages never extend in long discourses, Is not that a very true observation of human feelings?

When the lord of Flayel has caused his wife to eat the heart of the lord of Coucy, he contents himself by saying to her, while showing her the letter that the noble sent to his love:-- (Old French poem).

Does the lady pour out imprecations, wring her hands, make a long discourse, and express her horror by exclamations? Does the author say that she became livid, remained voiceless, or could only articulate hoarse sounds? No, the author understands that this vengeance, displayed in a most disgusting meal, will easily fall into the ridiculous. The passion and despair of the woman are expressed by some words full of nobility and s simplicity; so well that the husband is vanquished. (Old poem).

It is only when she is in the midts of her women, far from the scene of the trigic banquet, and before dying that she expresses in some verses the most touching regrets.(Old poem).

Sometimes a thought filled with energy pierces the discreet murmur of passion in the French poems of the middle ages. In the same romance, when the two lovers are to separate, the l lady desires lord de Coucy to carry away the long tresses of her hair, he resists. (Old French poem).

But we are far from the fables and their striking charm. The plastic arts are the living image of these feelings, sometimes tender and even elevated, without ever being bombastic, t the artists, like the French poets of the middle ages, are a always restricted by the fear of overreaching the aim by insisting; it is a case here for following their example. Only at the end of the 13 th century, artists commenced to select some satiriridal scenes from these fables in the 14 th century, they entirely freed themselves, and did not fear to personify a criticism of the customs adopted everywhere under the form of fables. In the 15 th century occurs a veritable unrestraint, and those grotesque and ticklish subjects, that we t then see reproduced even in edifices consecrated for worship, are not the product of barbaric caprice, but an increasingly vivid protest against the abuses of the age, and particularly the religious orders. We cannot repeat too frequently, that t the inferior lay class during the middle ages follows from t the 12 th to the 15 th centuries a logical course. It could express its feelings of anger, its love of satire, only in the productions of art; this was the sole liberty left to it; it profited largely by this, and with persistence that in spite of the liberty in form, sprung from the instinct of the just and true, very laudable, that we should be very wrong to misunderstand.

FACADE. Facade. Front.

The name of facade is applied today to the entire architectural arrangement looking on the exterior, the public street, a court or garden. But it is only since the 16 th century in France, that have been erected facades as one would arrange the decoration before an edifice, without taking more or less care for the relation of this facing to the internal arrangem-

arrangement. The ancients, nor the architects of the middle a ages did not know a facade arranged with the sole thought of pleasing the eyes of the passers. The external fronts of the good monuments of antiquity or of the middle ages are only t the expression of the internal arrangement. As for churches, for example, the principal facades opposite the chevets are n nothing but the transverse sections of the naves. For houses, the facades on the street consist of a gable if the house presents its end, or of a wall pierced by doors and windows if on the contrary, the house presents its longer side to the e exterior. Every building of the middle ages is always built o on a parallelogram, the gables being raised at two opposite ends. Thus, Fig. 1, the building of the middle ages presents two gables A and two side walls B. If several buildings are joined together, they form a combination, Fig. 2, of a greater or lesser number of these distinct buildings, and their f facades are nothing more than a more or less decorative arrangement of the openings on the exterior. This principle sufficiently shows that what we understand today by facade did n not exist in the architecture of the middle ages. A palace or house possesses its external fronts, but these fronts are nothing but a necessary appearance of the arrangements of the plan, of the lodgings or internal construction. In brief, in the architecture of the middle ages, the facade cannot be separated from the general arrangement of the building, for it is the result. We refer our readers to Arts. Cathedrale, Chateau, Maison, Palais, Architecture Religieuse, Monastique and Militaire.

FAITAGE. Ridge.
Upper part of a gable roof. (Arts. Charpente, Crete, Faitiere).

FAITE. Ridge-piece.
Horizontal timber connecting the two upper ends of the principals of the trusses. (Art. Charpente).

FAITIERE. Ridge Tile.
Crowning tiles of a gable roof. These tiles are plain or decorated, single or double. When they are ornamented, they form an actual ridge of terre cotta more or less open against the

sky. Ridge tiles of the Romanesque epoch are generally of very large dimensions, set jointed, and frequently ornamented by knobs serving to set them easily. These knobs form the continuous ornamentation of the cresting of the ridge. We have also seen on the roofs of the church of Vezelay remains of very o old ridge tiles (probably of the 12 th century), not less than 2.3 ft. long, and that must have been set jointed with a mortar joint between them.

Here, Fig. 1, is one of these ridge tiles of terra cotta of good quality, glazed bluish-green on the exterior. The ends A were slightly raised to remove rain from the joint, which was filled with mortar. The knobs project 4.7 to 5.9 ins, and were very rudely modeled by hand. Later it was recognized that these jointed ridge tiles, in spite of the mortar joints,allowed wet to pass into the carpentry, and these ridge tiles were l lapped as indicated by Fig. 2. Yet to prevent their disarrangement by the wind, they were always set on mortar, taking care to leave no crevices. About the beginning of the 13 th century were also made ridge tiles for covering tile roofs (3), each ridge tile having a hollow A for covering the round B on the next one. A fire glaze always covered these ridge tiles to make them less pervious to water, and to allow less hold for the wind, for the wind does not act on a smooth as on a rough surface. It is certain that the tile-makers of the middle ages observed in making ridge tiles the laws that governed lead-w workers; they understood that these ridge tiles must have considerable weight to resist the wind and to strengthen the ridge of the roof, that always needed to be loaded, principally when these roofs were composed of trussed rafters (Arts. Charpente, Crete); hence they soon gave them ornamental appendages, that are only slightly projecting knobs or low reliefs during the Romanesque epoch, then more decided and projecting forms, and consequently great weight. Some years since were to be s seen in the little museum installed by M. Ruprich-Robert in one of the dependencies of the cathedral of Bayeux, two ridge tiles of terra cotta, very curious in their manufacture. We give both here (4, 4 bis). They appear to belong to the 13 th century, are of small dimensions, and the glaze covering them is brown. These ridge tiles were set jointed. One still sees at Troyes on houses near the cathedral some ridge tiles accor-

according to the drawing, Fig. 5, glazed brown. These perforated appendages forming the cresting were necessarily fixed o on the ridge tile before burning. But in the fire they frequently cracked or bent. These pieces of terra cotta by their form and dimensions occupied much space in the furnace, were difficult to store, and their buring must often be very unequal. When in the 14 th century public and private edifices became richer and more refined, it was necessary to give the c crests of roofs covered by tiles more slender forms, more ligntly outlined against the sky; then were made ridge tiles w with ornaments that harmonized. After that system were made the ridge tiles of church S. Foi of Schlettstadt. [1] These consist of the ridge tile proper, Fig. 6, being a double pierced stem with round hole into which fits a small iron pin. The upper part of this pin above the bed B receives the maple leaf A, properly modeled and glazed. These ridge tiles date from the beginning of the 14 th century. The rusting of the lins a and the small bearing of these ornaments must cause breakage of these delicate stems, yet men proceeded to give increasong importance to the crestings of terra cotta; about the 15 th century they returned to uniting before burning, but placing the raised ornaments on the lower ridge tiles, that were short, and only decorating the ridge tiles by slightly projecting ornaments. According to this method were made the old ridge tiles of the roof of the cathedral of sens, whose covering of glazed tiles dates from the end of the 15 th century.(7). The sub-ridge tiles A are glazed yellow, and the great ridge tiles are glazed green. [1] One notes the holes that pass through the double curved vase of the sub-ridge tiles; these holes are s scarcely visible at the height at which is placed this cresting, and have no purpose other than to produce whistling under the action of the wind, and which probably pleased very much the neighbors of the church. We have frequently found on the crownings of edifices, and particularly of the roofs, traces of these singular musical caprices. During the middle ages m men did not attach to certain natural phenomena the romantic ideas suggested to us by modern literature; whistling of the wind through the buttresses and perforations of edifiles, which produce gloomy thoughts in our minds, was perhaps for the ears of our fathers a pleasing harmony. However that may be,

the idea of crowning the roof of the edifice by a hundred whistles is passably original.

Note 1.p.362. This drawing was furnished to us by M. Boeswillwald.

Note 1.p.364. Fragments of the ridge tiles collected by M. Lefert, diocesan inspector of Sens, deposited in the office of the agency of the works.

To avoid the difficulties still presented by the firing of the pieces A of the preceding Fig., it was conceived to make the upper pieces set to cover the others as we see done for the terminals of terra cotta. (Art. Epis).

Here (B) is a cresting so combined. [2] The lower ridge bears a sort of neck B (see section B'), on which is set the cap C in the form of a turret pierced by 4 holes. The lower ridge is glazed blackish-greenlike the ridge, the caps are covered by yellow glaze, and the little cone is black. There is reason to believe that all tile roofs were formerly crowned by these perforated ridge tiles; only a small number are now found in place; but thanks to the well known negligence of roofers, who do not take the trouble to lower the replaced tiles when they repair roofs, one can collect in the haunches of the vaults of our edifices of the middle ages a quantity of fragments of pottery, often very precious, since they give us specimens of these decorations of roofs; hence we cannot too strongly recommend architects called to repair old buildings to examine those fragments accumulated beneath the roofs by the negligence of roofers.

FANAL. Beacon.

(Art. Lanterne des Morts). The beacons designed to present at night a light to guide mariners on the sea or rivers, consisted only of a great lantern suspended to a crane at the top of a tower. The Tower of Nesle at Paris bore a beacon kindled each night to indicate to seamen the entrance of Paris. On the seacoast, where these lanterns could not furnish a light sufficiently strong to be seen afar, there were placed on the towers iron crates filled with tarred oakum. Watchmen were charged with maintaining these fires during the night.

Note 2.p.364. Fragments found on the vaults of the church of Semur-en-Auxois. tho- appear to date from the 15 th century.

FENETRE. Window.

The architecture of the middle ages being perhaps of all kn known architectures, that which most exactly submits to the needs, convenience, and the arrangements of programmes, it d does not present a great variety of windows, particularly at the time when this architecture abandoned the Romanesque tha-ditions. Indeed the window is made to give light and air to the interior of a hall or chamber; if the nave be great, it is n natural for the window to be great; if it be only necessary to light a cell, it is understood that the window may be small. In a church where men gather to adore the Deity, there is no need to see what passes outside; but in a hall for a civil use, on the contrary it is necessary to be able to look out of the windows; to look from the windows it is necessary to open them easily. Thus there are the general rules that must produce a difference in the forms of windows belonging to religious a and civil edifices.

The private habitations of the Romans were not at all arranged like ours. The rooms reserved for sleeping, in brief, the bedrooms, were small, and often received light only through the door opening on a portico. For rich men were established, besides courts surrounded by porticos, large rooms intended f for assemblages, banquets, and sports, and they took care as much as possible to arrange these rooms with the most favorable orientation; then frequently the windows were only closed by gratings of wood, metal, or even of stone and marble. Although the Romans were acquainted with glass, they did not make it in large pieces; it was evidently an object of luxury, and in common houses it was probably omitted, or at least used with parsimony. During the first centuries of the middle ages, glas must have been a material so rare that men avoided to use it. Note this first, that even today in Italy, Spain, and even in southern France, there is not required in interiors the light, that we love to diffuse in our apartments or in our public edifices. In southern countries life is outdoors, and men rarely shut t themselves in, except to meditate and sleep; now to devote one's self to meditation there is no need of much light, still less to sleep or rest. The Romans did not modify their architecture by reason of climate, but built at Cologne or Paris as at Rome, and left in Gaul traditions abandoned only quite late. In pub-

public edifices windows were great round-arched openings pierced beneath vaults through the enclosing walls; in the habitations the windows were only very narrow rectangular openings to receive wooden gratings on which was placed oiled paper or canvas, or bits of glass were inserted in the network of wood or metal. Rarely in public edifices were windows glazed; or indeed they were sufficiently narrow to prevent the wind from sweeping the interiors; or if large, they were furnished with gratingsof stone, metal or wood intended to soften the wind coming from the exterior. Many churches and Romanesque halls until the 12 th century possessed windows without any closure or grating. The form of these windows is introduced in Fig. 1. Not having sashes, it was natural to arch these openings and to give them a large splay inside to facilitate the entrance of light. When these openings were narrow (which was common, to break the force of the wind as much as possible, they did not take the trouble to turn a cut arch over the jambs externally; but contented themselves with cutting the stone in the form of an arch, and the cut arch was reserved for the splay, in order to support the load of the upper construction. The external construction forming an arched lintel, had only the thickness of the slab A B (2). Nearly always during the first centuries, i.e., from the 8 th to the 11 th, the jambs of these openings consisted of great stones on end with bands above the sill and under the arch. The primitive Romanesque window was thus constructed like the antique window. As for the proportions of these windows opened in edifices, they are subjected to the place assigned to them; then are generally short in t the lower stories and long in the upper stories. Besides the idea of defense dominating all Romanesque structures of the 8 th to the 12 th centuries, men took care to open only small windows in the ground story, often too narrow for men to pass through; or indeed if induced to make rather wide openings, the window was divided by a little column as indicated by Fig. 3. In this case the window really consisted of an arch having the width E F and round arch D; on the exterior were set double arched lintels C on a little column, whose actual function was to serve as the closure or grating. The round arch D did not appear externally and served as a discharging arch from H to K. Our Fig. shows at A the window on the exterior, at B is

the section through the middle of the little arches ^ and the great arch D.

In the provinces the windows, during the Romanesque period and up to the middle of the 13 th century, present striking differences. Relatively wide in the north, they are narrower as one approaches the south; yet there are some exceptions to that general rule, thus the windows of the religious edifices of Auvergne, Saintonge, Perigord and a part of Languedoc, during the 11 th and 12 th centuries are ar wide as the windows of Ile-de-France and Normandy, while on the banks of the Saône and the Rhone they are very narrow. We shall give here some examples of the religious edifices or of public monuments erected on the same principler for the arrangement of the windows. It is a law already observed by the Romanesque architects and developed with much intelligence by the constructors of the 13 th century, that it is necessary for us to make known fully to our readers, for it seems to have been nearly forgotten in our time. The light passing through a window into an interior forms a cone or pyramid according to the form of the opening: i.e., that instead of being divergent, the luminous rays converge from the exterior to the interior; thus let (4) there be an opening a b c d, the exterior being at A, the direct a and full light forms a pyramid a b c d e, and all not comprised in that pyramid will only receive diffused or reflected light. A pyramid will be longer or shorter according as the o opening is more or less orientated toward the course of the sun. If the rays themselves of the sun pass through this opening, the luminous group will form a prism, but which is not infinite. For example, assuming a square opening a b c d in the wall (5), the exterior being at A, the solar rays passing through that opening will form a prism a b c d, a'b'c'd'. But if we have at B a wall distant from the opening more than 20 times the diagonal of the square, the projection of these solar rays through the wall will be already much changed; if this wall be at a distance of 100 times the diagonal of the square hole, it will have only a diffused spectrum; if much farther, the solar rays will leave no trace; the direct solar rays will leave no trace; the direct solar light is then itself changed by the sides of the opening allowing it to be introduced into the closed nave. A person placed at the back

of a cellar 1641 ft. long whose opening is only 6.6 ft., assuming that the solar rays pass along the axis of the cellar, will perfectly distinguish the opening, but will receive no light. Thus even assuming the direct solar rays, the luminous groud always diminishes in diameter from the exterior to the interior; hence every window must have an opening proportioned to the extent of the interior to be lighted; if this opening be too small, one sees the window, but it no longer gives direct light, and it is not so much the number of windows, that gives a clear light in the interior as their relative dimensions. A square hall with sides of 32. ft., lighted by 20 windows, each with 10.76 sq. ft. area, would be quite dark at i its centre, while 2 windows of 107.6 sq. ft. each pierced in two opposite walls would light the centre sufficiently for one to read there. The luminous surfaces, in brief the windows, must then be calculated according to the extent of the interiors. It is understood that we speak only of windows taking direct light from the sky, for if they only receive reflected light, it is evident that the luminous pyramid or cone produced in the interior would be much shorter. Observation gradually led the architects of the 12 th century to apply these laws, that the love of symmetry has caused us to neglect, for to obtain on the exterior facades pierced by windows of similar dimensions, we have come to light great halls and little rooms by means of similar windows; we no longer know, or we no longer desire (to satisfy certain classical laws that the ancients took good care not to apply) to produce great effects of light in interiors by means of windows more or less large; we have lost the sentiment of the picturesque in the mode of lighting interiors. Yet the arrangement of openings in the i interior, especially if the nave be grand and divided as one of the means for obtaining powerful effects without cost. We see Romanesque architecture, when it separated itself from barbarism, carry very far that knowledge of the introduction of daylight into the interior of churches and its great halls; that architecture admits that certain parts of the nave must be lighted more than others; it will overwhelm a sanctuary w with light and leave the nave in half light, or indeed will open enormous windows in the ends of transepts, while leaving the sanctuary in obscurity, or again indeed it will pierce s

small windows in the walls and side aisles, so that they will make the high vaults luminous; it will proceed with light as it proceeds when it is necessary to decorate an arrangement; it knows how to make sacrifices; it is sober here to appear more brilliant at some point; it employs means that had been the privilege of our art before the classical era; it thinks that the windows do not exist for themselves, that their dimensions and form are the result of the interior to be lighted. It is to be believed that Greek architects, Roman architects, and those of the middle ages would be very much surprised, if they saw us give in publications on the art of architecture examples of windows without stating how, why and where these openings are made, what are the halls lighted by them. That is indeed as strange, as it would be in a publication on natural history of animals to give a collection of ears, presented without taking into account the heads that bore them. An ass' ear is certainly very beautiful, but on condition that it ornaments the head of an ass. Hence we shall endeavor in presenting examples of windows, since this concerns this important architectural member, to indicate their places and f functions, and to explain the reasons that caused the adoption of such a form and arrangement.

FENETRES APPARTENANT A L'ARCHITECTURE RELIGIEUSE.

Windows belonging to Religious Architecture.

We have already stated that in the old churches, i.e., in those built from the 8 th to the 11 th centuries, the windows received no glass, and that glass was an exception; that these windows were open, or partly closed to stop the wind by gratings of stone, wood or metal. That was an antique tradition. In the rude provinces of upper Burgundy, the Cluniac churches permitted no closure of their windows until the 12 th century. The windows of the nave of Vezelay, 1100 to 1110, upper and lower, were without glass or gratings, allowing the air and light to pass freely. Here is Fig. 6, one of those windows.[1] The horizontal section of these openings at A gives a double bevel without groove or stop to receive a sash. This bevel on the exterior had the advantage:- 1, to allow the light to enter readily; 2, to obstruct the action of the wind, that entered between these two inclined surfaces. A slope B outside rejects rain. In the interior the sill C extends at the level

of the abacuses of the capitals. The archivolt D is placed directly under the side arch of the vault; the round arches of these openings are then concentric with the side arches, but profit by the height of the side aisles to introduce the most light possible. At E we present the external view of this window.

Note 1. p. 370. Of the side aisles; those of the high nave are traced on the same plan but are longer and have inside a much inclined sill to allow the light from the sky to strike directly on the floor.

Yet in the provinces of the West about the same epoch, manners were more civilized, and the interiorswere not thus left exposed to all winds; at the end of the 11 th century the windows were small, narrow and often fitted with stone gratings of quite delicate work and pleasing design. There exist but a very small number of examples of these gratings, later replaced by glass. We give one in Fig. 7 from the church of Fenioux.[1] This is a slab of stone 2.2 ins. thick for a width of 10.6 ins. The stone is hard and delicately cut; the openings are beveled externally and internally. Our Fig. represents t the external face of the slab, which is not set in a groove but in the splay of the opening, as indicated in Fig. 7 bis, A being the outer side. The jambs of the windows opened in the walls of religious edifices of the 10 th and 11 th centuries were generally without any ornamentation; the archivolts alone in the 11 th century were sometimes surrounded by a rope moulding, solid or with billets; yet already in the sanctuaries men sought to avoid an excess of simplicity by placing under the archivolts two little columns as piers, and that as the sort of enclosure giving importance and richness to the openings. That method is followed in the monuments of the provinces of the Centre, which date from this epoch, in Auvergne, Nivernais, Berry, a part of Languedoc, Lyonnais and Limousine. The slabs in the windows remained simple and are as if surrounded by the arch supported inside on little columns. Thus are made the windows of the sanctuary of the churches of Notre-Dame-du-Port at Clermont,[1] and of S. Etienne of Nevers.[2] These last windows were always closed by panels of pieces of glass set in leads and maintained by means of iron bars.(Art. Vitrail). When the naves had tunnel vaults, the windows very

rarely penetrated the vault, the extrados of their archivolt being set directly under the springing of the vault; this arrangement compelled the architects to carry their eave walls much above the eave walls of these windows in order to be able to place, either the mass bearing a covering and laid directly on the vault, or carpentry. That portion of the base wall above openings relatively small produced a very bad effect; hence in provinces where the art of Romanesque architecture had attained a certain degree of elegance and refinement, men sought to decorate those bare parts. The walls of the cathedral of Puy-en-Velay present one of the motives of external m mural decoration between the windows pierced beneath the high vault and the cornice. (8). Sunk panels arranged in the thickness of the wall decorated by mosaics and little columns occupy the bare parts, enclose the openings in graceful fashion without taking from the construction a solid appearance that it should retain. The window itself is covered by a well cut double archivolt, the external one resting on two little columns. Thus from the small openings, really very simple, the architects of Auvergne of the end of the 11 th century have made an ornamental motive of great importance to the exterior.

Note 1.p.371. M. Abadie collected fragments of gratings, t that he very kindly communicated to us. The church of Fenioux depends on Saintonge, it is located now in the department of Charente-Inferieure; it is one of the most curious monuments of that part of France.

Note 1.p.372. Art. Chapelle, Figs. 22, 27.

Note 2.p.372. Art. Arcature, Fig. 12.

It is unnecessary to enlarge further on Romanesque windows of religious edifices; besides that they present few varieties, we shall often have occasion to give examples of them in the course of this work, and this would form a double use to present here a great number; yet we must mention certain works, that belong exclusively to the Carlovingian monuments of the East, and that possess a special character. These windows are double or trible and rest their archivolts (9) on single small columns of marble or very hard stone (to resist the load), surmounted by an abacus extending in one direction for the th thickness of the wall; an arrangement that section A will make understood.[1] In this case the little columns were only struts

set at the middle of the thickness of the wall and supporting the equilibrated load. It is unnecessary to state that these windows were not glazed; hence they were usually opened only in towers or galleries not opening into the interior. This sort of windows are seen in some Italian towers built of brick, pretended Lombard towers.

Note 1.p.373. From the cathedral of Spires (towers), 12 th century.

Let us come to the epoch of transition during which the windows of religious edifices assumed very diverse forms.

The cathedral of Noyon, built about 1150, shows us already a system of windows entirely novel. The upper parts of the t transepts of that church, built in circular plan, are lighted by long twin round-arched windows opening on the external gallery passing through great buttresses abutting the edges of t the vaults. The plan in Fig. 10 shows us twin windows at C w with their rebates to receive glazing, the external gallery at B, the interior of the nave being at A. A long and small monolithic column repeats externally the double opening while allowing as much light to enter as possible. A discharging arch resting on the jambs and the little column n supports t the upper cornice.

The perspective view (11) taken externally, illustrates the entirety of that arrangement, then novel. By this means the architect obtained in the interior beneath the vaults a very beautiful light; he possessed a service gallery that facilitated setting and maintenance of the glass, the projection that sheltered them from wind and rain, the construction both light and solid, for the great discharging arch is double and b bears the upper part of the construction and carpentry. One perceives here already that the architects sought to introduce wide luminous rays into the interiors, that they suppressed the walls and felt the necessity for increasing the translucent areas as they erected greater monuments. This true principle rapidly brought very important modifications in the structure of religious edifices. The space left between the piers bearing the vaults and the side arches of these vaults became a glazed opening; but as it was necessary to maintain an iron framework to support the glass, and these frames presented an enormous surface to the wind, the openings were divided by p

piers, arches, eyes and stone tracery, which opposed a solid obstacle to the effect of the wind, that were durable and allowed one easily to replace portions of the glass brogen out by hurricanes. The stone filling being for the architects so much a necessity of construction, that they did not place it in openings, that by their position near the ground or their narrowness imposed by the small distance between the piers, could without inconvenience be fitted with simple iron bars. For example, in the side aisles, the architects also did not believe it necessary to entirely open the walls between the buttresses, because the side aisles not being very wide needed no such great area of light as the principal naves, since men still adhered to Romanesque traditions, and always closed well the lower parts of edifices. In church S. Yved of Braisne the side aisles of the choir and high nave even present t these windows in a state of transition (12), while in the c cathedral of Soissons, the lower windows are nearly similar to those of S. Yved, but the high windows of the nave alreadv possess stone tracery constructed of courses under the archivolts concentric with the side arches of the high vaults. Fig. 13 shows us one of these openings on the exterior; at A we h have traced the section of the archivolt and of the tracery on a b. A projecting passage on the exterior beneath the sills of thise windows and covering the triforium, permits placing and repairing the glass without difficulty. If one looks for an instant at the construction of the stone tracery; he will see that the construction consists of a central pier, of two arches with extradoses, an independent eye receiving in a g groove cusps forming a rose with 6 lobes. Between the eye and these arches is set the filling of masonry. The ccusps support at their ends by as many claws, the iron circle that serves to attach the glass panels. In each opening beneath the arches rises a vertical bar, crossed by horizontal bars forming a s series of regular panels. The glass are held to these bars by keys passing through loops and by grooves cut in the jambs of the central mullion. (Art. Armature). Thus from the end of t the 12 th century (for the windows date from that epoch or the first years of the 13 th century), the built mullions were adopted for the great windows of the great religious edifices belonging to the French provinces. It must be recognized that

the architects of this epoch of transition sought, experienced, tried several methods, yet only employing ture and simple means, knowing perfectly what they desired, but attaining the end by different ways. At Chalons-sur-Marne about 1170 the architect of the choir of Notre Dame also desired to abandon Romanesque traditions and to open great windows beneath the high vaults. How did he undertake it? Having obtained very wide bays by t the location of the piers, he raised the side arches of the vaults as much as possible, taking care even to trace them in a very flat pointed curve, Fig. 14. Beneath thise arches he opened three windows of almost equal height, separated by two little piers. The engineering of Champagne was always in advance of the adjacent provinces, and led the constructor to c connect the window with the triforium; he then carried the two little monolithic columns A of the piers separating the openings down to the sill of the triforium, setting two small corbels to receive their bases. As for the two other little columns B. at the jambs, they descend to the abacuses of the lower capitals, for one will observe that here is no projecting moulded side arch, and that the vault rests directly on the upper tympanum C.[1] The arrangement of the windows, instead of being separated from the arrangement of the triforium, as in the edifices of Ile-de-France of the same epoch, is connected with it: which singularly enlarges the interior of the nave. This triforium is very small, and its scale is reduced because it becomes only the opened sill of the window. At D we have given the plan of the openings at the level D′, and at E the external face of the archivolts of the three windows, that c can be glazed on the exterior by the gallery serving to cover the triforium.[2] In regard to this one will observe that generally the high windows are glazed from the exterior, while those of the side aisles near the ground are glazed from the inside. There are good reasons for so proceeding: that the low window being glazed from the outside, it is easy for criminals to remove at night some keys and bars, to displace a panel of the glass and enter the church: while that operation cannot be attempted if the panels of the glass are set, the keys and bars being inside. But in the upper part of the edifice, that danger would not be found, while it would be necessary to take certain precautions to prevent the rain driving against the

glass from entering between the panels; then the panels being set inside and the heavy winds driving the rain against them, the water stopped at each cross rod and easily entered at their joints; there was then the advantage of glazing the windows most exposed to wind on the outside; thus could be arranged the overlapping of the lead of one panel over another, obtaining a smooth surfacewithout projections, stopping the raindrops at no point. But it may perhaps be thought that we e enter into minute details; yet in truth there is no deteil in the execution of architectural works, that does not have its importance, and the true artists are those that know how to devote care, observation and study to the least details as to the most important; hence the architects of the middle ages were true artists.

Note 1.p.378. For the section of the windows with the general system of the construction of that choir, see Art. Construction, Fig. 43. At S. Remy of Rheims, the construction of th the upper windows of the choir is similar to this.

Note 2.p.378. See Art. Construction, Fig. 43.

About the beginning of the 13 th century, the architect of the cathedral of Chartres sought combinations of windows entirely novel for lighting the high nave. In the side aisles he was restricted to the custom of the time, i.e., he had pierced windows terminated by equilateral arches, not filling the space between the piers; he had desired to leave to this substitute the appearance of a wall. But we see that in the upper part of his edifice he changes the system; from one pier to another he turns round side arches, then in the enormous bare space remaining in each bay above the triforium, he erects two wide windows surmounted by a great rose window, Fig. 15, (see section C); A is the side arch forming the archivolt on the exterior, doubled by a great arch D giving the thickness of the vault V. The enclosure of the rose R receives in a groove slabs pierced by quatrefoils and forming wide voussoirs. At B are traced the elevations of the flying buttresses. It is well to compare these windows with those given above (Fig. 14) or the old ones of the cathedral of Paris, very little earlier. One recognizes in this construction of Notre Dame of Chartres a boldness and power, that contrast with the experiments of the architects of Ile-de-France and of Champagne.

At Chartres is seen for the first time, the construction frankly adopt the upper windou occupying the entire width of the bay, taking the side arch of the vault as the archivolt of t the window. Simplicity of composition, true and solid construction, strong jointing, beauty of form and judicious use of materials, all qualities are found in this magnificent specimen of the architecture of the beginniug of the 13 th century. Further do not forget these arches, piers, pierced slabs, are made of stone from Berchere of strength under any test, easily quarried in great blocks and of coarse appearance; which also adds to the grand effect of the masonry. One cannot doubt that the quality of the limestone materials employed by t the architects of the primitive Gothic epoch was for much in the adoption of the system of construction of the great windows. What was done at Chartres at the beginning of the 13 th century, could not have been done with the materials of the basins of the Oise, Seine, Aisne and Marne. In those provinces men did not think of employing pierced slabs or could not do so; windows were coupled, enlarged as much as possible, b but did not dare to close them with stone tracery. In Burgundy where the materials are very resistant, about the second half of the 12 th century, rose windows were filled by tracery of pierced slabs (Art. Rose), but not in the other windows. At Laon about 1150, the architects also hesitated between the forms of windows of the Romanesque epoch and those recently opened in the religious edifices adjacent, like the cathedral of Noyon, the abbey church of S. Denis. In the gable wall of the transept of the abbey church S. Martin at Laon, although the structure of the church is already Gothic, we see windows that do not entirely abandon Romanesque traditions (16). Round and pointed arches mingle, and the new school only appears in the form of the mouldings. Even here the round arch appears above the pointed arch; which also proves that during the epoch of transition, the architects felt themselves free to adopt either of these arches according to the needs of construction. The lower window is covered by the pointed arch, because this window is wider than the other, and the constructor has wished to give more solidity to its construction by supporting the jambs of the upper window on the spandrels of the arch, whose profile approaches more nearly the horizonta, line. He was e

evidently preoccupied by the effect that might be produced by the jamb of the window on the voussoirs of the round arch between the impost and crown; the pointed arch is only a means of avoiding rupture at the middle parts of the archivolt at right and left. Do not lose sight of this; about the middle of the 12 th century, the architects had seen such a great n number of Romanesque edifices fall, particularly at the time when men had desired to give them very great dimensions, tha t they must have observed the effects of settlement and rupture produced in these structures, and that they constantly feared to see these injurious effects reproduced. The pointed arch was they used, as one employs a new procedure recognized as good, i.e., always when they had a doubt of the efficiency of the old methods. It could only be given to men already experienced, bold and certain of their means of execution, to still employ the round arch for such great spans, as did the architect of Notre Dame of Chartres.

With stone from Berchere, one could be combined with a system of mixed tracery, like that adopted for the high windows of the cathedral of Chartres, i.e., composed of voussoirs forming an elastic and resistant skeleton, and of thin slabs perforated like the closures of antique windows; but all materials did not lend themselves to the use of these procedures. In Champagne, although the constructors possessed materials of great dimensions, they did not find in the quarries of the province beds with sufficient resistance to permit the use of this wide tracery composed of slabs. They proceeded differently and made stone sashes to maintain the panels of glass, by means of jointed arches, one turned within the other and independent. This system was complete in the construction of the windows of the chapels of the choir of the cathedral of Rheims, which must have been erected about 1215. Conformably to the method of Champagne, the windows permit enclosures by pointed arches, wide splays terminating inside like the side arch to receive the fillings of the vaults, and bearing the projecting moulding on the exterior under which meet two pointed arches of the rose window,only resting on these two arches w without intersecting the mouldings of the archivolt. A Fig. is necessary to explain this very important construction in which is given to us the transition between bar and plate tr-

tracery. We give then (17) a perspective sketch of the upper part of those windows taken from the interior of the chapels. One sees at A the side arch-soffit that belongs to the primitive Gothic style of Champagne, the side arch whose section is given at B. Beneath this arch-soffit is turned the archivolt C, only continuing the section of the little columns D and a double bevel receiving the groove for the glass. At E is the impost, that receives one of the arches resting on the central mullion G. The crown of this arch is then intersected by the rose, that is only placed between the voussoirs of the archivolt C. In its turn the rose receives in a groove the c cusps that do not have a groove but staples inside to maintain the glass panels. Do not forget to note that the little columns of the central mullion as well as those of the jambs are not connected to the construction, but are set on end according to the method used for most little columns at the end of the 12 th century. On the exterior these windows give the elevation (18). The archivolt C being a discharging arch is naturally subject to the settlements and movements suffered by the structure; now the rose being left free and maintaine d only by friction with the spandrels of the archivolt, does n not risk being broken by these settlements; it may be slightly deformed like a ring of iron or wood under pressure, but could not break. There is a mark of foresight acquired by long observation of the effects manifested in such vast structures.

All the windows of the cathedral of Rheims are constructed on this principle. Our elevation (18) indicates at A the section of the upper part of the window, B being the internal a arch-soffit. There is seen at C the mode in which are inserted the cusps of the rose, maintained at their ends D by the iron ring and the keys E; at G are rebates for the glass set inside. One will note that this rebate in the sill, whose section is traced at I, returns to cast on the external slope H the rain or drip running down the glass. A perspective detail K shows this double arrangement of the rebates. At L we have traced a horizontal section of the mullion and jambs with the projection of the circular wash M; at O the intersection of the bases of the little columns of the jambs and mullions is established on a plane of this wash. (Art. Chapelle, Figs. 36, 37).

Whether the windows of the cathedral of Rheims are narrow

or wide, they only have a centaal mullion and two openings; it then results that these spaces are either 3.9 or 7.5 ft. wide. To maintain the glass panels in sucn wide openings were required very strong iron bars. They soon adopted a system of multiplying the mullions for wide windows, so as to have always nearly equal spaces. Instead of a single mullion, there were placed three so as to divide the opening into four parts of equal widths. Only about 1240 occurred this important modification, and thenceforth whenever the nature of the materials permitted, the tracery was only set on end and fixed in a groove under the archivolt. Among the most beautiful and t the first windows of the kind must be mentioned those of the upper S. Chapelle at Paris. One finds there again, Fig. 19, a principle that dominates the construction of the windows of the cathedral of Rheims, i.e., that the openiug is divided into two parts by a vertical mullion A supporting two pointed arches and a rose. But the two large divisions a B are themselves bisected by the secondary mullions C, that also bear pointed arches and smaller roses, so that the spaces to be glazed are only about 3.3 ft. wide. The archivolt D (see section 8) fills in the interior the function of the side arch and receives the fillings of the vault F. The second archivolt G serves as a discharging arch, supports the gutter, the external balustrade and the eave wall H on which rests the carpentry. One sees at I gargoyles with tails penetrating to the haunches of the vaults to cast off rainwater, that fell on these v vaults before the completion of the construction and the placing of the covering. At the S. Chapelle of the palace one s sees originate the gables over tne archivolts of the windows; gables that are at the same time a decoratior and a means of maintaining the archivolts in their planes. (Art. Construction, Fig. 108). At K we have traced the whole of the window, that has in height three times its width; at L are iron ties that prevent deviation of the buttresses, connect them together and prevent the mullions from leaving their plane. Further this tracery is not cut in courses but in large stones set on edge, that permits less breadth and leaves more space for the glass; as for this, its panels are maintained in the windows of S. Chapelle by bars of wrought iron and by grooves cut at the middle of the thickness of the tracery as indicated at V.

These windows are glazed from inside, and the iron bars project outside the panels, but are set in such a manner as to entirely clear the grooves. The section of the sill is traced at N, these sills always bearing a little shoulder O inside to throw outside rain entering the crevices of the panels. In the windows of the upper S. Chapelle are seen that arches and openings of the tracery are accurately comprised within the h height of the archivolt. This arrangement had one defect, it caused the little columns of the tracery to appear too high, not giving sufficient importance to the upper tracery. The a architects of the middle of the 13 th century observed this bad effect, and they soon lowered the arches of the tracery and the upper openings below the springing of the architraves. But about the end of the first half of the 13 th century, in religious edifices the windows were combined, either with the arcade of the substructure when they were pierced in the ground story, or with open galleries in the second story, when t they opened in the upper part of the high nave. Already at t the upper S. Chapelle of the Palace, the internal arcade serves as a sill for the great windows, like those of the lower chapel. (Art. Arcature, Fig. 8). If in the upper S. Chapelle this arcade cannot be absolutely connected to the tracery of the windows, still the divisions correspond to the spaces of the tracery; the architects thus seemed to desire to make the windows start from the ground, i.e., to compose their edifice only of piers and openings, a portion of which was closed below. This was a means of giving grandeur to the interiors of religious edifices. We have seen that the architects of the churches of Notre Dame of Chalons-sur-Marne and of the choir of S. Remy of Rheims, had sought to connect the upper windows with the triforium. In the cathedral of Rheims this principle was not followed, but we see that in Ile-de-France and Picardy it was freely adopted at least for the upper windows.

The nave of the cathedral of Amiens presents one of the first and most beautiful examples of this system. In that nave the upper windows and the triforium form an entirety, although this triforium is still closed and has a special arrangement. This new method has such importance, and it so clearly indicates the purpose, that the architects proposed to attain, viz:- to entirely suppress the walls, what are termed the hangings

in trade terms, that we must give here an illustration of those high windows in the nave of Notre Dame of Amiens. (20). At A is traced the internal faces of one of these windows, at B its section on C C'C". The transverse arches of the great vaults rest on the columns D, and the diagonal arches on the little columns E; the archivolt of the window takes the place of the side arch. Then in that construction are only piers a and windows. The triforium is actually connected to that opening, not only by its decoration, but also by its construction. Yet the roof H of the side aisle abutting against that triforium, the partition I closes the gallery, and the discharging arch O bears the upper passage, and forms a strut between the piers that receive the columns of the head M of the flying b buttress. The middle piers P are placed over the crowns of th the archivolts of the side aisles, so that all the weight is thrown on the piers of the nave. The middle mullion of the o opening is built in high courses, but already the intermediate tracery is only composed of large slabs of stone set on edge. The cusps of the roses, large and small, are inserted in a gr groove in the principal part of the upper tracery.[1] These openings being of considerable dimensions, t was thought proper to multiply the iron cposs bars, to place verticals at the middle of each space, and to fit the upper rose with a strong r ring as much to relieve the cusp as to resist the weight of the glass panels. If the triforium already here forms a part of the window, yet it is still a distinct architectural member, it is not an opening, and permits to be seen parts of hangings between its archivolt and the sill of the great opening. These dark recesses and plain surfaces below the great glazed parts of the high windows plagued the logical minds of the a architects of the 13 th century. In fact the triforium was no longer a closed gallery passing beneath the windows, it was already the substructure of the window, but one not joined to it with sufficient intimacy. In arranging the roofs of the s side aisles as hip or terrace roofs, men could also make openings in the wall of the triforium; but then it was necessary to omit those solid tympanums and high sills, to decidedly e extend the great openings of the naves down to the sill of t the gallery, giving it only the solid parts absolutely necessary to find a service passage at R. In the choir of the same

cathedral, this new programme was solved with certain experiments; the solid tympanums over the archivolts of the triforium still exist; it was indeed sought to make them lighter by gables with crockets, but the separation between the window and the gallery no less existed (Art. Triforium). In Champagne and Ile-de-France the problem seems to have been solved in an absolute manner for the first time. The nave and the high parts of the choir of the abbey church S. Denis, built about 1245 (20 years after the nave of Notre Dame of Amiens), show us windows only forming a single entirety with the treforium.[1] These windows further present certain special arrangements, which have a meaning from the point of view of construction. Let us first indicate this rule to which one finds few exceptions; the tracery of the windows always presents a principal division, so as to furnish two spaces only if these openings are narrow, and two spaces subdivided by secondary mullions if the openings are wider; thus the windows possess spaces in equal numbers, two and four. These divisions are again subdivided if the windows are of extraordinary width to form eight spaces,[2] i.e., the principal mullion, two secondary and four tertiary mullions, in all seven mullions. There is recognized this system of crystallization, let us say, toward which Gothic architecture falls by a fatal descent after the middle of the 13 th century. For example, it is known that the architects having admitted that to maintain the panels of glass, it was no longer necessary to leave more than about 3.3 ft. between the mullions, without being compelled to place iron muntins between these mullions as in the preceding example; that from the moment when these mullions were regarded as stone sashes intended to maintain these panels, it was illogical to double them by vertical bars of iron, and these architects were soon induced to set as many vertical stone mullions with intervals of three ft. to receive the glass. If a window 6.6 ft. wide is to be glazed, the architect places one mullion (21). If it be 13.1 ft., he places one principal and two secondary mullions (22). For 26.3 ft., he places a principal mullion, two secondary and four tertiary mullions (23). But then the rose A and the compartments B become so large, that it is impossible to glaze them without employing very complex iron frames; it is necessary to avoid these. Combinations of stone

cusps are sought to fill these spaces as we have sketched at C, for example. The sash is then complete and iron is merely accessory, only placed in the form of crossbars fitted with loops. We have stated already, that the defect of the high windows of the S. Chapelle of the palace was to present too long mullions for the upper tracery, this not descending below the imposts of the archivolts. The architect of the nave of Notre Dame of Amoens, before the construction of the S. Chapelle, h had already extended the upper tracery below the imposts of the archivolt-side-arches (Fig. 20). But the more the mullions were multiplied, and the lower the tracery extended, as s shown by the two Figs. 21, 22, it was indeed necessary as shown in Fig. 23, to trace inner pointed arches more nearly approaching the round arch than in the other examples.

Note 1.p.388. For details of the construction of this tracery, see Art. Meneau.

Note 1.p.391. Some arrangement in the high part of the choir of the cathedral of Troyes, which seems to precede by some y years the structures of the 13 th century of the church S. Denis. The architecture of Champagne is nearly always in advance of that of the adjacent provinces, and even of Ile-de-France.

Note 2.p.391. We find exceptions to this rule at the end of the 13 th century in the church S. Urbain at Troyes. One sees that it is always Champagne that introduces innovations in a architecture.

The high windows of the nave of Notre Dame of Amiens possess a central mullion showing greater width than the two others. In fact the weight of the tracery rests almost entirely on t that mullion; this had no inconvenience when the central mullion was still composed of courses or high stones, not being of a kind to split. If on the contrary, one desired to make these mullions of long stones that might split, it was a serious danger to transfer the entire load to the central pier. The architects of the churches of S. Denis, the cathedral of Troyes and of some other religious monuments erected at the middle of the 13 th century, retained the general arrangement indicated in Fig.20, but for greater safety gave an equal section, if not an equal thickness to the three mullions of the great openings; i.e., (Fig. 24) [1] they annexed two windows w with a single mullion in each. Thus all the principal members

of the tracery retained the same width, and the stone sash h had equal stiffness over its entire surface. At A we have traced the section of the central mullion and of one of the intermediate mullions; at B the section of the window on its a axis. Here the cusps of the roses are not set in the groove as at Amiens, but belong to the general stonework; which allows giving them greater lightness, obtaining more strength a and to diminish the strength of the iron bars. As we have just stated, the triforium is intimately connected with the window, opened like it, and the tympanums intended to support the ceiling of the passage C present only plain surfaces of little importance. An external wall D is opened like the gallery E, although simpler in cutting. To this wall D are attached the panels of glass. The iron bars G form a continuous tie passing through the piers and mullions, and connecting together the entire construction. Soon men desired even to suppress these little solid tympanums above the archivolts of the triforium, and to have only tracery without interruption other than the ceiling course between the upper gallery and the window. The windows of the triforium then appeared to be merely a single opening divided by mullions and entirely opened tracery (Art. Triforium). Then the bays of the great naves were composed o only of the arches of the side aislesand of windows comprising the entire space left between the top of the archivolts of these bays and the high vaults. If the sanctuaries had side aisles, these were entirely opened by means of the glazed g gallery surmounted by the window comprising the entire space between the piers. Thus was constructed the choir of S. Urbain of Troyes, which presents to the eyes only the splendid l lantern of stained glass resting on the closed base, only from 9.8 to 13.1 ft. high.[1]

Note 1.p.393. Upper window of the choir of the abbey church of S. Denis.

Note 1.p.395. Art. Construction, Figs. 103, 104, 105, 106.

We have given in Art. Chapelle, Figs. 4, 5, 6, the arrangement of the windows of the royal chapel of the castle of S. Germain-en-Laye, an arrangement that opens the entire space b between the buttresses of the edifice by isolating the side arches of the vault, so that on the extérior this chapel allows to be seen only as solid parts great piers and great rec-

rectangular tracery windows. This tendency to leave entirely open the walls of religious edifices between the buttresses, to only construct piers supporting vaults with translucent o ornamentation instead of walls, is evidently the preoccupation of architects from the middle of the 13 th century. From the moment that were adopted colored glass windows, mural painting could produce but slight effect in interiors, because of the lack of white light and the brilliancy of the glass; then was adopted the system of having only translucent painting, to which was given the greatest area possible.

Champagne precedes the other provinces of France, when it became necessary to adopt that system. The side aisles of the nave of S. Urbain of Troyes, whose construction dates from t the end of the 13 th century, present between the buttresses that arrangement of rectangular windows, very rich and independent of the vaults. The architect of this curious church, desiring to adopt the broad scheme in a little edifice, that cannot be praised too much, divided his nave in only three bays. The side aisles are covered by cross vaults on square plans; but as the spaces between the buttresses would have been too wide to open a single window between the piers, except by g giving it a width greater than its height, which would have produced a very disagreeable effect, or to leave between the openings and the piers wide piers,that he wished to avoid, t this architect then divided each (Fig. 25) bay of the side a aisle by a rib A, that springs from the pier and buttress B smaller than the buttress C, which receives the flying buttress. In the spaces left between the large and small buttresses he opened windows D, ending rectangularly beneath the gutter, a and independent of the side arches of the vaults. But he has desired to give to the exterior as to the interior great richness in these windows. Fig. 26 presents the external elevation of one of these openings at the scale of 1 y 50. At A is one of the great buttresses and at B one of the small ones. T The section E is made through the balustrade at E'. The course forming the gutter resting on the tracery is at G. The section C at 1 : 25 is made across the mullion at the height H, and t that at D across the same mullion is at the height I. The glass is set in the grooves K. If we make a section on the axis of that window (Fig. 27), we have the central mullion at A, the

little buttress at B, and at C beneath the side arch of the vault is tracery, that is merely a decoration. One sees that the gutter G rests on this side arch and on the external tracery. Let us examine this window from the interior of the side aisle, Fig. 28. At A we have indicated the glazed tracery, the window that supports the gutter G, and that is accurately comprised between the buttresses; at B is traced the internal tracery beneath the side arch C of the vault. By the jointing, that is accurately traced, it is recognized, that this tracery is completely independent of the construction of the buttress, that it is merely perforated slabs cut in an excellent lias from Tonnerre. The construction thus only consists of b buttresses or piers supporting the vaults; then as the enclosure there are only perforated walls placed outside the receiving gutter. These are actual frames set later, to be changed, repaired or replaced without touching the edifice. There is no need to emphasize the advantages that result from this system, perfectly reasoned, that allows the richest and the lightest decoration without loss of solidity and simplicity of the structure.

Yet during the 14 th century was abandoned, even in Champagne, this system of windows inscribed in rectangular forms for religious edifices, and men returned to taking the side arches of the vaults as archivolts of the openings; but the tracery became gradually more delicate, arriving at sections of extreme delicacy in order to leave to the glass, i.e., the colored ornamental surfaces possible. (Art. Meneau).

FENETRES APPARTENANT A L'ARCHITECTURE CIVILE ET MILITAIRE.

Windows belonging to Civil and Military Architecture.

In antique Greek and Roman architecture, the internal structure of the interior to be lighted determines the form and dimensions of the windows. The same principle is applied with still more rigor by the architects of the middle ages. If the arched for is suited to openings with fixed glass, and that are inscribed by vaults, it will be agreed that this form can scarcely be applied to openings, that must be opened frequently, and that are made between floors. As we stated in commencing this Article, the windows in the first centuries of the middle ages very rarely were glazed in public edifices; but it was indeed necessary in private habitations to protect per-

persons from cold and wind, even if only during the night; t then these windows were closed by wooden shutters; when air and light were desired, the shutters were opened. The inconveniences of this primitive mode soon compelled the architects to pierce some holes in these shutters, that were covered by glass or parchment. Then they came to make wooden sashes receiving glass, paper, parchment or linen.

Some windows of habitations of the 11 th century, for example like those of our old Norman keeps, permit no trace of an old closure to be seen; it is to be believed that they were closed by mats, curtains of wool or coarse linen; indeed one frequently sees in Carlovingian manuscripts representations of openings fitted with these movable curtains sliding on rods, and held by loops when it is desired to cause air and light to enter interiors. Certainly urban habitations, those of citizens devoted to any work in the interiors of their houses, already had windows, glazed or covered by parchment, while castles still retained the ancient customs, for the feudal lords and their men only assembled in the evenings in their lodgings to eat and sleep; they had no inside work, and passed nearly all their days in riding over the country.

In the houses of cities, the need of introducing light into interiors (streets were generally narrow) was the motive of those glazed colonnades, that we find in nearly all French habitations after the 12 th century. The work of M.M.Verdier & Cattoison the civil architecture of the middle ages furnishes us with a great number of examples of those continuous windows, that occupy the entire side of the principal room in the second and even third stories, a room that served as a palce for work and assemblage for the entire family. But these cannot be regarded as windows, properly speaking; we shall have occasion to describe them in Art. Maison.

The Romanesque civil window is usually narrow, composed of two jambs covered by a jointed arch or cut in a lintel with a discharging arch behind it, or a second lintel presenting a course sufficiently strong to receive the beams of the floor. Sometimes the window is nothing but an arched opeiug, like those presented in Figs. 1 and 2. Yet these openings (because of the arch terminating them) were closed with difficulty by blinds, as these could not be developed under the arches; the

persons from cold and wind, even if only during the night; t then these windows were closed by wooden shutters; when air and light were desired, the shutters were opened. The inconveniences of this primitive mode soon compelled the architects to pierce some holes in these shutters, that were covered by glass or parchment. Then they came to make wooden sashes receiving glass, paper, parchment or linen.

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use of this method was soon renounced, the openings were enlarged and divided by a mullion or little column. Fig. 29 shows us the Romanesque window of the end of the 11 th century, that by the preservation of all its accessories supplies a remarkable example of the system of closure generally adopted at th that epoch. It comes from the castle of Carcassonne.[1] At A is traced the plan. Its total width between the inside jambs is 3.9 ft., and the depth of the recess is 1.95 ft., half the w width. The little white marbel column supports the external lintel cut out in two arches. (See the ekternal front of the opening at B). This lintel I is doubled inside by a second lintel K and a third lintel L (see section C), that is made of a block of concrete [2] that receives the beams of the floor. Two hinge pins G are still in place (see inner elevation D), and received a divided shutter, that when opened swung against the jamb and wall as indicated by the plan. When it was desired to close the window, the two leaves of the shutter were closed and a wooden bar was drawn out, whose place is indicated on the plan and the sketch D at F, until the end of the bar entered the hole P.[3] The sill of the window formed a bench in the interior of the room.

Note 1.p.401. Inner facade of the gate tower.

Note 2.p.401. See Art. Beton, Fig. 1.

Note 3.p.401. See Art. Barre for means of drawing this sort of closure.

We give (30) the internal elevation of this shutter at O, and its section on a b at M; the drawn bar is indicated at R. Openings glazed by pieces of glass set in lead admitted light into the room when the blinds were closed. The hinges were d divided like shutters, as indicated in our Fig. Here the height between the floors was too small to allow the use of the internal discharging arch; but generally the inside of Romanesque windows divided by a little column is surmounted by a round discharging arch.

Here (31) is one of the windows of the keep of Falaise, whose construction dates from nearly the same epoch. The plan A shows us that the opening really consists of a loggia or round arcade, externally closed by a sill wall, a little column and two reveals. On the exterior (see sketch B) the window d does not show the round arch of the inside recess, but only

the two little arches resting on the little column. Internally (see sketch D) one notes that the window offers a recess from which by advancing to the sill C, one can see the foot of the external wall. These windows seem not to have been originally closed by shutters, but as we have just stated, by mats or hangings suspended beneath the great arch. A little later we note that in these Norman castles are used solid w wooden shutters to close openings, allowing the great arch of the recess to appear externally, and opening a transom beneath the arch.

Thus are constructed some windows of the castle of Harcourt at Lillebonne and of several other Norman castles of the 12 th century. Fig. 32 explains that arrangement. Sketch A shows us the exterior of the window, and B is its section. Under t the round tunnel vault E of the recess is turned the arch D, whose imposts rest on the ends of a lintel C and on two jambs. A mullion relieves this lintel at the middle of its span. The space between the lintel C and arch D was permanently glazed, and solid shutters, divided and barred, closed the opening b behind the mullion. Later when the closures of the windows w were glazed, there was still retained the fixed transom above the opened portion. This tradition remains in France until o our days, since in many habitations of the last (18 th) century are still seen windows with impost lights, frequently fixed. In fact, when one desires to look out of a window, it is very inconvenient to open a sash 9.8 or 13.1 ft. high, olten difficult to move it when dampness has swelled or dryness has shrunk it, and that allows the passage in winter of a volume of air much greater than necessary. It must also be said that rooms intended for habitation being much larger than those of our apartments, they did not feel the necessity for renewing the internal air so frequently as today. The wide fireplaces caused a sufficient draft for the external air in winter, so that it was unnecessary to open the windows; and in summer a coolness was obtained by keeping them closed. It was only when one desired to look into the street, that one half opened a small opening sash, allowing one or at most two persons to lean over the sill. Yet in the 13 th century were renounced bars placed in the thickness of the walls and drawn behind the shutters, and instead of solid shutters or those pierced

by small openingswere established entirely glazed wooden sashes.

Here (33) is one of the windows of the beginning of the 13 th century, pierced in the old buildings now depending on the c citadel of Verdun. This is still the Romanesque system. The lintel is relieved by the pointed vault of the recess that appears externally, and is pierced by a quatrefoil permanently glazed; but the two windows are fitted with glazed sashes hung on hinge pins fixed in rebates, held beside the mullion by bolts sliding into the stone projection B, reserved inside t the mullion. The ingenious minds of the lay architects of the 13 th century invented novel and very varied arrangements for the windows of civil and residence buildings. We seen that in certain cases they retained the pure Romanesque tradition, i. e., they opened in the wall the round arch, and placed a lintel below this centre to receive a rectangular sash, as in a turret belonging to the bishop's palace of Soissons (34); (beginning of the 13 th century); or indeed for small rooms they adopted openings wide in comparison to their height, separated by an elegant central mullionexternally covered by a lintel decorated by arches, and internally forming a recess covered by a discharging tunnel vault, and furnished with a bench B (35).[1] Here the mullion is reinforced internally by a brace A serving as an arm, and receiving the bolts for closing the two sashes. (Art. Banc, Fig. 4). We likewise see that to light rooms quite high between floors, they arranged windows so as not to be ab able to open at one time but a part of their area; then the c central mullion is divided by a transom bar (36), and the opening has four movable sashes, the lower opening to look outside, and the upper to admit light into the upper part of the room, always with projections on the mullion to receive the bolts.[2]

Note 1.p.407. From a house of Flavigny.

Note 2.p.407. From a house of Flavigny, middle of 13 th cent.

Still were required from architects about the middle of the 13 th century larger windows to light houses or public edifices; as manners became more refined, men desired more open h houses, and not walled like fortresses. Especially in the cities of Ile-de-France and of Champagne was perceived in the reign of S. Louis a tendency toward those needs of modern civilization.

There still exists at Rheims the facade of a house quite c complete on Rue du Tambour, the house called that of the Musicians (Art. Maison), which dates from about 1240. The rooms of the second story are lighted by wide and high windows (37), whose elevation we give at A, at B being the internal elevation, and at C the section. The cornice D of the house is set directly on the lintels of these windows, behind which are t turned relieving arches E, that bear the carpentry of the roof. The mullions are so arranged as to receive glazed sashes without the aid of any ironwork. First at G is set under the relieving arch an oak lintel with holes at its ends corresponding to the circular projections F made at the two ends of the stone cross-bar H. These projections, whose perspective detail is drawn at I, receive the pivots K of the lower and upper s sashes. Other like projections O from the sill P receive the bottom pivots of these lower sashes. The bolts of the four s sashes enter the projections R left inside the central mullion. We give at a scale of 1 : 10 the section of the mullion at L, at M the side of one of the projections, and at N its inside face. [1]

Note 1.p.409. See Architecture Civile of MM. Verdier & Cottois. The House of the Musicians is given in that work with most of the details of the facade on Rue du Tambour.

These examples emphasize the care that the architects of that epoch took in the study of the minute details of domestic architecture. All was foreseen during the construction, a and all was provided with economy. They avoided those iron fastenings, which after the completion of the dressing of the facade defaced them by intersecting the mouldings, injuring the jambs and mutilating the panels and sills; which required that patching with plaster soon destroyed by time, and thus accenting the little harmony that exists in our edifices between the appearance and needs. In Gothic houses, now regarded as habitations foreign to our civilization, the windows, like the other architectural members, are not imitated from the a antique or the Italian Renaissance; but they are arranged and made to give air and light, they are proportioned to the rooms, and comprise in their construction all accessories indispensable for opening the movable sashes as well as closing t them. We might then find here some good instruction, if we

would become acquainted with those simple means, with that c care in everything which nowise excludes improvements, but on the contrary aids them.

But the examples that we have just given heee last are taken from private edifices; yet the architects of the middle a ages erected vast halls devoted to civil services, or that combined both a religious and civil character. Such were the halls of synods, great interiors destined for great assemblages, where it was necessary to find air, light and grand arrangements; in brief, what is required in our halls and courts. One yet sees near the cathedral of Sens one of those halls, formerly dependent on the archeepiscopal palace.

About 1245 under king S. Louis was built the hall of the s synod of Sens. On the public place and facing west, it is lighted by windows, admirable in style of the architecture, perfectly appropriate for their purpose and with construction s showing the hand of a master. We givi (38) the exterior of t those windows. The hall being vaulted, the archivolts of the opening are concentric with the side arches of the vaults, a and are arranged according to the system of Champagne. The glass comprised in the tracery A is fixed, as in the windows of religious edifices; but the openings B are rectangular and fitted with opening sashes, so as to permit persons within t the hall to have air and to look outside. In the interior these windows present the perspective sketch (39). This beautiful composition is repeated at the southern end of the hall, but with four bays instead of two; the immense upper opening with tracery surmounts these four openings. Here it is seen that the mullions are furnished with projections intended to receive several bolts in the height of the opening sashes, so as to prevent the bending of these sashes.[1] One will note how the jointing of these traceries is well arranged to present great stability and to avoid crevices. The cusps of the rose (Fig. 38) are set in the rebates, and the lintels of the opening portions are relieved by two strong archivolts, that rest on the strong middle pier. These windows have a particular c character, that does not belong to the style of religious architecture, although thew are placed under vaults like the w windows of churches. (Art. Salle). The architects of the 13 th and 14 th centuries did not employ this system of fixed glazed

tracery with opening sashes merely in great halls. We see windows of moderate dimensions so arranged in habitations; the t two volumes on Architecture civile et domestique by MM. Verdier & Cattois,[1], supply us numerous examples, although they have not been able to collect all.

Note 1.p.411. The restoration of this admirable hall, mutilated by time and the neglect of past centuries, was undertaken by the care of the minister of State. The government appreciated all the importance of this monument now unique in France, and that furnishes an example from which can be derived the most useful information for the construction of our great halls for large assemblies. The building was sold during the r revolution, and was purchased by the ministry of public instruction and worship. Thus it now belongs to the State. The preservation of the synod hall of Sens will be a fact the more remarkable, that the administration had to struggle against certain men, for whom every expense not presenting a character of material utility, immediate and local, is a lost expense; but in France we cannot restrict ourselves to erecting markets, abattoirs and hospitals and viaducts. It must be recognized, that at Sens as at Pont-du-Gard and Carcassonne, the enlightened persistence of the administration daily finds the most vivid approbation of numerous visitors among us, who happily think that the monuments of the past merit being preserved a and drawn forth from oblivion in which they were formerly left.

Note 1.p.414. Two volumes in quarto. 1855.

There exists in the second story of gate Narbonne at Carcassonne, built about 1285, a hall of moderate height between floors, lighted from the side next the city by openings presenting a miniature of the windows of the great hall of Sens. The upper part of these openings (40) received fixed sashes. In the interior behind the cross-bar A was placed a wooden bar, (see section C), against which shut in a rebate two opening sashes. A wooden muntin was held by a joint in that bar and a pin in the projection D, was placed behind the mullion and had projections receiving the bolts of the opening sashes. These opening sashes not having water outlets, and not covering the sill E (see detail G), but shutting against the inside of that sill at H, the rain entering between the glass must necessarily run inside. To avoid that inconvenience, the con-

constructor cut at F little gutters with two holes K by which the water passed outside. The opening sashes were held in the rebate by hing pins and straps. The elevation I shows the exterior of the window. The upper tracery is moulded inside the same as outside, since the glass is set at the middle of the thickness of the stone as indicated by our section, while the jambs, mullion and transom bar are cut square inside to receive the sashes and joinery as indicated by our plan.

The forms of the windows opened in civil edifices and the h houses of the 13 th and 14 th centuries are too varied for us to present to our readers a specimen of each sort of these o openings. Always the dimensions or the nature of the halls determined the arrangement, heights and widths of these openings; which was reasonable. That mode of procedure gave architects more trouble, than they take today, when the same window serves for an entire story of a palace or house, whether that story comprises great halls and little rooms, or it contains stairways and mezzanines.

Still about the end of the 14 th century the customs of the lords and citizens were much softened, and it was found that the opening sashes set in rebates in the stone itself without fixed sashes admitted the cold air from outside; then they t thought to make the wooden sashes independent of the stonework, i.e., the mullions and transom bars. The castle of Pierrefonds was built in 1400 and supplies us with beautiful examples of windows arranged with fixed wooden sashes set in rebates in the stone, and receiving movable glazed sashes and internal shutters.

Fig. 41 gives at A the plan of one of these openings, at B ist external elevation, and at C its internal elevation. On this last drawing, in which we have indicated the opening with its shutters at D, with its glazed sashes at F, omitting the joinery, one sees that the movable sashes as well as the shutter are hinged, not to the stone but to fixed frames set in the wide rebates of the jambs, mullion and transom bar; th that one can open separately each shutter and each glazed sash, which for great windows presents advantages; that the shutters are more or less opened to allow the external light to illuminate the little chambers when these shutters are closed; that these openings close as well as ours if not better, that they

can be made airtight, and that by means of those separate sashes, one can give interiors more or less air and light. All that has been replaced now by casement windows, but we have not yet replaced those shutters opening in small sections. As always, when the walls are quite thick, benches occupy the recesses so as to be able to sit near the window and breathe at ease.

Windows of the civil architecture of the 15 th century conform to these general methods and receive fixed sashes; their mouldings become more complicated on the exterior, and mullions and transom bars thinner to allow passage of more light; t their lintels are ornamented as well as their sills, they are enriched by sculptures, and the end of the 15 th century has left us a number of windows with mullions of a delicacy of w work, that much excels what was done in the 14 th century or in the epoch of the Renaissance. We shall terminate this Article by giving one of the windows of the second story of mansion de la Tremoille at Paris.[1] These windows (42) rest on a solid continuous balustrade forming the sill; their lintels are placed at the level of the cornice of the building, that receives the gutter and roof. Probably finding that this mode of terminating the opening was poor, the architect judged it proper to erect over these lintels a high decoration in perforated stone, that forms a sort of crown for the window, and that intersects the monotonous mass of the roof. The gutter t thus finds itself stopped at each opening, and bears a projecting lead gargoyle above each pier. Frequently (and that was justified by the need) these crowns of openings placed on the cornice are only great stone dormers, that light the attic s story. Thus terminate the windows of the palace of justice of Rouen, which are the richest of this kind in France in combination, and more surprising in stonecutting and workmanship. (Art. Lucarne).

Note 1.p.416. This mansion was demolished in 1841. We possess a complete monograph of it (see Architecture Civile et Domestique of MM. Verdier & Cottois. Vol. 2).

The mullions and transom bars persist in the windows of French civil architecture until the beginning of the 17 th century, because until then the sashes open in small parts, and men did not suppose it would be convenient to handle sashes

and shutters 9.8 ft. high. Du Cerceau shows us again the windows of the Louvre of Francis I and of Henry II with stone mullions. Mullions also were in the openings of the palace of the Tuileries. The omission of these accessories, recognized as necessary under the reighn of Louis XIV, entirely changed the character of this architecture by reducing its scale; divisions in joinery do not have the monumental appearance of stone mullions, without giving more light for the interior of the apartments. (Arts. Maison, Palais).

FERME. Farm Buildings. Barns and Sheds.

Rural structures designed for the cultivation of the domain. The Romans were great lovers of rural establishments, and in the vicinity of their villas, sometimes even within their enclosure, they possessed buildings indended to preserve harvests, lodge colonists and enclose animals. The Frankish chiefs appear to have desired to adopt these habits, when they took possession of the soil of Gaul; but their scorn for manual l labor and of those engaged therein, their taste for arms and a life of adventure raraly allowed them to occupy themselves with the details of a country life. If they caused to be stored in their villas abundance of grain, wine, forage and products of all sorts, this was to consume them with their companions in arms, and to waste in some nights of orgies the harvest of a year. One understands that those customs were unsuited to encourage agriculture and establishment of buildings intended for systematic cultivation.

About the beginning of the 11 th century the monasteries a already seriously occupied themselves with agriculture on a great scale. They built barns, cellars, presses and stables, they executed important works of irrigation, and applied themselves to improve the lands, clear the forests and collect n numerous herds. In truth, even the first monasteries built by the Cluniacs more nearly resembled what we call a farm today than anything else. (Art. Architecture Monastique).

Later monks, lay nobles and chapters, caused the establishment of farms according to the arrangements adopted in our d days, and we see that in 1234 a canon of Notre Dame of Paris agreed to build within one year a barn to revert to the chapter after his death. "The court or yard of the barn must be

256 ft. in length and 192 ft. in width; the enclosing wall to be 18 ft. high not including the coping. In this wall must be made a gate with a postern, and over the door of the postern must be built vast and substantial granaries; this was properly the barn. It must have at least 128 ft. length and about 57.5 ft. width, with gutter at the height of 12 ft. Near the gate a shed of 64 or 77 ft. was intended for the habitation. On the rear gable must be built a turret sufficiently large to contain a bed and stairs. There must be used for the construction of the turret good oak wood, great and strong, and good tiles. The angles of the walls as well as the gate must be of cut stone. Finally there must be built a great and good press covered by a good shed roof of tiles."[1] There still exists in Beauvoisois, Soissonais, the vicinity of Paris and Touraine, quite a large number of these farm buildings of the 12 th and 13 th centuries,[2] notably very beautiful barns (Art. Grange), and dovecots (Art. Colombier), which have almost always belonged to religious establishments. As for the general arrangement of farm buildings, it is subordinate to the site, particular needs, and orientation. It is never more than a collection of separate buildings enclosed by walls and oftey by ditches. Even sometimes these farm buildings were fortified; the enclosing walls having watch-towers and turrets. One still sees some of this sort in Burgundy, Auxois, Lyonneis and Poitou.

FERME. Truss. Roof Truss.
A carpentry term. By it is understood every carpentry member that forms a series of bays. Men say roof truss, scaffold truss. (Arts. Charpente, Echafaud).

FERMETURE. Fastening.
(Arts. Barre, Fenetre, Porte, Serrurie.

FERRURE. Ironwork.
(Arts. Armature, Serrurie.

FEUILLURE. Rebate.
A recess formed in the jamb of a door or window to receive the leaves or sashes. (Arts. Fenetre, Porte). Permanent sashes also have rebates, when they receive movable sashes. (Art. Menuiserie).

FICHAGE. Pointing Stone Masonry.

Act of pointing joints in stone masonry.

FICHER. To point Stone Masonry.

To point the stone is to introduce mortar under its bed when that stone is set on slips. Usually during the middle ages stones were not pointed, but were set on a bed of mortar, which is much preferaple, for it is difficult, when a stone is set on slips, to introduce mortar in its bed joints, and especially to compress that mortar so as to avoid settlements. However when one proceeds by underpinning and facing, it is impossible to set the stones on a bed of mortar; in that case to a avoid the shrinkage of the bed of mortar and to compress it, when this mortar begins to set, it is well to force it back with an iron blade and a mallet. To point stones is employed a tool called a jointer, its iron blade has saw teeth and a wooden handle; this blade is straight (1) or bent (1 bis). One attaches a wooden board fitted with two iron angles C and points B at the level of the stone to be pointed; the ends B entering the joint. A tender places the mortar on this board, that the pointer with his trowel and jointer forces under the block. When the mortar refuses to enter and comes out on the upper bed of the stone, the stone is well jointed and liffed around its back. Then after this mortar has acquired consistency, it is driven with the iron tool (2). It is well to leave an inch open under the bed next the face. This space is filled later by repointing, this is a means of certainty that the stone is set on its edges, and that it will not spall under the load.

FILET. Fillet.

This name is given to a projection of the stone designed to prevent rainwater flowing on surfaces from entering between the roofing and the masonry. A covering of metal, slates or tiles, cannot adhere to the stone, there always exists a separation between this covering and the construction of stone that rises above it. If this joint, necessarily imperfect, be marked by a projection that carries off the water, leaks occur under the roofs, causing the floors and vaults to decay. Today sheet zinc is inserted in the stone above the roofing, or more

frequently a joint is made tight by a fillet of plaster, that quickly disintegrates or breaks my the movement of the carpentrn subject to successive swelling and shrinking. The architects of the middle ages had the precious advantage over us of foreseeing everything during the construction of public and private edifices. Fastenings of sashes, rebates, setting ironwork, and numerous details that must occur in the entirety of a simple or complex structure, were calculated, foreseen and executed during the construction. But it was particularly in the system of removal of water, that those architects excelled us. They directed minute care to establishing permanent fillets suited to cover the joints of coverings with vertical surfaces, particularly after the end of the 12 th centurw, the time when they commenced to erect very vast edifices, on which even because of their great areas, the removal of water presented difficulties. In the Romanesque of the 11 th centurw however, it is already seen that the architects have preserved the junction of the shed roof of the side aisles with the wall of the central nave by means of projecting fillets (1). These follets extend around the projections of the buttress, horizontally at first (sketch A), then soon following the slope of the roof (sketch B), so as to leave everywhere between that fillet and the roofing only an equal space, sufficient to insert lead, slates or tiles. But difficulties present themselves, f for example, when shafts of buttresses or chimneys pierce the slopes of the roof (2). If the fillet A B prevents the water flowing down the surface D from entering between the covering and the side of the pier, it is necessary at C to find means of removing the water flowing down the covering, to the right and left of the thickness of that pier. There the fillet would be useless: it is necessary at C to have a gutter to discharge its water either on the roof, or into another gutter following the slope of the covering. This last means was thought of at first. Indeed the shafts of the flying buttresses of the choir of the cathedral of Langres, which dates frsm the middle of the 12 th century, presents to us gutters arranged as indicated in Fig. 3. The gutter A receives the water from the upper slope of the coveriug; B at the side receives the water falling into the gutter A and on the ends of the tiles downwards. When the roofing is placed around this shaft, it assumes the

arrangement given in sketch T. Thus with no fillets of plaster or mortar, the upper gutter sends its water into the inclined gutters, that empty at the lower part of the pier into t the gutter I. At the cathedral of Langres, the inclined fillets are cut in a single great stone, made possible by the slight slope of the roof. This primitive method presents its i inconveniences. It is necessary to raise the tiles to join t the upper gutter A, thus leaviug the interval between this raise and the continued slope of the roof; further, along the end D of the upper gutter rainwater can still pass between t this and the tiles. Later a greater inclination was given to the roofing, and inclined channels were omitted, which then could not be cut in a single course, they returned to fillets for covering the inclined parts, leaving the gutter only at the upper partfor receiving the water for the thickness of t the shafts of buttresses or chimneys.(4). Little gargoyles p placed at both sides of the thickness cast the water from this upper gutter on the slopes of the covering. Sketch A gives the elevation of this arrangement. A slight raising of the s slates, tiles or metal at C cast the water into the gutter, which because of the enclination of the roof, could easily be thrown on the roofing, passing under the inclined fillet E. Sketch B presents in perspective the gutter and fillet, the roof being assumed to be removed.

These details sufficiently emphasize the care devoted by a architects of the middle ages to those parts of the construction so much neglected today, but which have great importauce, since they contribute to the preservation of edifices. It is due to this care that most of our monuments of the 12 th and 13 th centuries are yet standing today, in spite of prolonged neglect and frequently of ignoraut restorations. We dare not predict such long duration for our modern monuments, if they have to suffer the same negligence and the same lack of care; they will avoid great injury only if they are constantly maintained, their structure not hawing in itself the means of preservation, that we have seen adopted in antique architecture as in that of the middle ages.

FIXE. Oil Painting within Glass.

A painting done on a sheet of glass and protected from the

action of air by a covering of the same material. These were much used in the decoration of furniture [1] and even of interiors during the middle ages. A good number of examples are f found in the S. Chapelle of the palace at Paris and in the abbey church of S. Denis. They were also employed in small pieces to ornament the vestments of statues, fronts of altars, reredoses and tombs. They are even seen in pavements. (Arts. Application, Peinture).

Note 1.p.425. See Dictionnaire du Mobilier. Vol. 1.

FLECHE. Spire. Wooden Tower.

Habitually employed only to designate towers of carpentry covered by lead or slates, termina ing in an acute pyramid. Yet stone pyramids surmounting the twoers of churches are actual spires, and one can say; the spire of the old tower of Chartres, the spire of the catnedral of Strasburg, to designate the acute summits of those towers. In principle, every t tower belonging to the architecture of the middle ages is built to receive a spire of stone or wood; it was the required termination of religious towers. [1] Those conical spires or t those with square bases on the oldest monuments are at first of small height in relation to the towers, that they surmount (Art. Clocher); but they soon assume more importance, they affect the form of pyramids with octagonal bases; they end by becoming very acute, often have a height equal to that of the tower serving them as support; then they are pierced by dormers or openings, and finally form only a tracery of stone, li like the spires of the cathedral of Strasburg, Freiburg in t the Breisgau, Burgos in Spain. Very Shrewd constructors, as o one can recognize in passing through the Articles of the Dictionaire,, the architects of the middle ages must have devoted very particular study to the construction of these great pyramids of stone, which rise to considerable heights, and thus are subject to numerous causes of destruction. If they displayed in these difficult works a profound knowledge of the laws of stability and of equilibrium, of materials and of the effect of atmospheric agents on their surfaces, they have frequently made proof of an acute observation very rare in the composition of those great pyramids, whose entire outline is detached against the sky. Further, they found no example in

antiquity or the first monuments of the middle ages of this sort of compositions, that exclusively belong to that lay French art of the middle of the 12 th century. One will indeed note that before that epoch (Art. Clocher), the terminations more or less acute of church towers with round or square bases are only roofs of stone or wood, that have only a minimum importance, or that rather resemble a heap than an architectural composition. In spite of the effort of the architects, one feels that these coverings are not connected to the body of the structure, that they are merely superposed; while already the spire of the old tower of Notre Dame of Chartres forms with its base an entirety, a homogeneous composition. These qualities are still more apparent in the spires of Senlis, V Vernouillet, Laon, Rheims, Etampes.[1] By transitions skilfully arranged by the architects they proceeded from the massive s square base of the tower to the extreme point of the spire. Their attention was chiefly devoted to the outlines of these masses, for the least imperfection when the sky is the background shocks the least experienced eyes. Experience of each day (for us who think of everything but the outlines of our edifices, and who have adopted the rule of making architecture a sham ornamentation comprised in the mass, insignificant if not disagreeable) proves to us, that objects detached against the sky lose or acquire their relative importance, according to certain laws that seem very singular at first sight, and which still may be taken into account by calculation and reflection. These laws were perfectly understood by the architects that erected the immense spires of the middle ages, and one verifies their observation in even their most extraordinary works. Yet these laws could only be imposed after experiments by the tentative method, or rather by the aid of a very developed delicacy of the senses, since the monuments of this kind arose suddenly about the middle of the 12 th century, a already in the perfect state. The spire of the old tower of Notre Dame of Chartres, the largest that we possess in France, is perhaps the one combining in the highest degree those qualities in composition so difficult to acquire. The simplicity of its mass, the correct proportions of its various parts, its happy outline, make it an architectural work, that one cannot meditate on too much.

Note 1.p.426. See in the 7 th Entretien sur l'Architecture the facade of the church of Notre Dame of Paris with its projected spires left unfinished.

Note 1.p.427. The spires of Laon exist no longer, but their arrangement is known; those of the cathedral of Rheims are so easily divined, and we know those of S. Nicaise by good engravings.

It is necessary to establish certain general laws, that although very natural are often ignored when spires are to be erected, because we have a habit of composing entireties in elevation, as well as different parts of edifices, without t taking exact care of the effects, of perspective and development of plans.

Take (1) the square tower A B C D, on which we desire to eerect a spire with octagonal base a b c d e f g h; we draw t the elevation E on one of the sides of the square of the tower; we give the height of the pyramid 3.25 times the side of the square, and we find a suitable ratio between the height of the spire and its base; but if we make the elevation on the plane G H parallel to a diameter g c of the octagon, we obtain the sketch F. Already the proportions that seemed good to us in the sketch E are modified in a disagreeable way in sketch F; the tower becomes too wide for the pyramid, and that e even has the height of no more than 3 times its apparent base, which is the diameter g c. Further, the shadows produce a bad effect on that termination by always giving to the tower lighted sides narrower than those of the pyramid; this will cause it to appear wide at its base. Now it is necessary to take i into account, that the elevation E can only appear at four points, while that the views F are infinite; then will be the infinite number of disagreeable views against four good ones. But the disappointment will be much greater when the edifice is erected, and perspective comes to deform again the elevation E. Assume that we are placed on the prolongation of the line I perpendicular to the plane G H at 147.6 ft. from the point C (see sketch A A) at K, the tower being 32.8 ft from A′ to e′; that this tower is 131.2 ft. high from the ground to t the base of the spire. When the spire is seen at that distance, it will give the sketch B B, for this because the perspective will appear to have in height only about 3 times the length of

the diameter l m, as demonstrated by the perspective projection m o. If at that distance we desired to obtain the appearance O P R, it would be necessary to double the height of the spire and bring its apex to n. If we intend to obtain in perspective a proportion similar to that of the elevation E, it would be necessary to triple the height of the spire to bring its apex to p; we should then obtain the appearance S P R. Assuming that we retire more than 492 ft. at K′, we even still see that spire t u. If on that spire we place a point at the middle of its height at v, and we are at K″ (see sketch M), in perspective the distance x v′ would appear greater than t the distance v′r. If at y we place an ornament whose projection does not exceed one tenth the total height of the pyramid, in perspective this ornament will be one sixth of the apparent height of the spire. These laws, that already seem complicated, are however but very elementary, when the composition of spires is concerned.

FLECHES DE PIERRE. Stone Spires.

Spires constructed of stone after the 12 th century, with rare exceptions, having octagonal bases and placed on square towers, it was first necessary to find a transition from the square prismatic to the octagonal pyramidal forms. Without apparent effort, the architect of the old tower of Chartres knew how to obtain these transitions (2). At the level K that terminates the tower, the projecting angles have been concealed by slightly projecting buttresses, that flank them. The s story L is also vertical and presents in plan an octagon, whose four sides parallel to the sides of the tower are larger than the other four. Four dormer pinnacles occupy the corners of the square base, and fill the recesses left by the octagonal plan. Above, the vertical story is ornamented by four great dormers on the faces and recedes more at the small sides than at the large ones, reaching a nearly regular octagon at the base of the pyramid. Yet that still presents four sides (those of the fronts) a little wider (by a quarter) than those of the augles.

Fig. 3 shows us at A the plan of one eighth of the spire of the old tower of Notre Dame of Chartres at the level L, and a also at B, the level of the base of the pyramid. At C one sees how the projections of the buttresses bear the jambs of the d

dormer-pinnacles, and at D how the angles of the tower are c concealed, so that seen diagonally the spire continues the r rigid outline of this tower almost without projections. The p pinnacles C are entirely detached from the pyramid above the vertical story, so as to allow the light to pass between them and the spire. It is the same for the gables placed on the f front dormers; these gables are detached from the pyramid. Th This is accompanied by appendages that surround it and lead the eye from the vertical to the inclined line; but it is engaged to its shaft, and permits its principal form to be divined.

Our elevation (4) is taken between the level L and the tops of the gables, and emphasizes the merit of this composition, at an epoch when architects had not yet been able to acquire the experience, that later was given to them by the very frequent construction of great stone spires on the towers of churches. This drawing causes us to feel the study and care that already at that epoch were brought to the very difficult arrangement of this junction between the structure with square b base and the pyramid; but it also unveils to us the uncertainties of experiments. Those artists had not yet found a sure m method, but sought it; their taste and accurate eyes, their f foresight of effect led them to the true one, but by divergent and indecisive means. Search for the true one by artists, also endowed with unusual refinement, gives particular charm to this composition, the more that these artists only used simple means, that they thought first of all of the stability, th that like constructors they neglected in part; so well that this enormous spire, whose apex is 367.5 ft. above the ground, counts seven centuries of existence and has suffered two terrible conflagrations, but is still standing and inspires no fear of its durability. The pyramid has 2.6 ft. thickness at its base and 1.0 ft. at its apex, like the entire cathedral it is built of hard stone from Berchere, admirable cut. The sides of the little pyramids at the angles are 1.6 ft. thick. However at the level K, the tower stops abruptly and is leveled up, and from a sort of platform springs the termination. later the architects thought to better connect the towers and spires, as one can recognize by examining the tower of the c cathedral of Senlis (Art. Clocher, Figs. 63, 64), and the sum-

summits of the towers of the cathedral of Paris, whose buttresses end in pinnacles and cross-flowers, already preparing for the recessions that must be made by spires on those towers,[1] as may also be verified at the cathedral of Laon, whose towers in their upper parts are accompanied by great open pinnacles, that flank the great octagonal story forming a very well adjusted base suitable to receive spires.

Note 1.p.432. In the 7 th Entretien sur l'architecture, see elevation and facade of Notre Dame of Paris with its two spires.

The spire of the old tower of Chartres is only ornamented by scales that represent wooden tiles, at the sides and middle of the eight sides of the hips.

When architecture became lighter during the first half of the 13 th century it was found that these apparently solid pyramids seemed heavy above the lower opened parts; more elegance and lightness was then given to the dormers, and in the sides were then pierced long slots, that showed these pyramids to be hollow. We see this system adopted by the constructors of the spire of Senlis. The architect of the old tower of Chartres had already sought to partly remove the dryness of the long straight lines of his spire by projecting parts, heads, breaking at certain distances the lines on the eight faces, and by chimera figures placed at the starting of the hips, in the tympanums and on the apexesof the pinnacles and gables. These details in full relief and casting strong shadows, attract the eyes and give scale to the mass. They went farther; already at the beginning of the 13 th century, the hips had projecting crockets, that were detached agaenst the sky and gave life and more lightness to the rigid lines of the pyramids. (Art. Clocher, Fig. 63). We ewen see that along the buttresses of the towers of the cathedral of Paris was sculptured in each course a projecting crocket producing a broken outline below the spire, as if better to connect their hips to the angles of these towers. The spire of the abbey church of S. Denis, built about 1215, still retained its hips without o ornaments; but there it was erected on a tower of the 12 th century, whose severe and vertical forms did not lend themselves to these projections. From this point of view, the spire of S. Denis was a masterpiece. The architect who built it, while adopting the composition of the 13 th century, knew how

with much art to unite the forms accepted in his time with st-still Romanesque construction in appearance on which it was t to be placed. That spire gave a most happy outline; so justly it was the admiration of Parisians and foreigners. Its necessary destruction to avoid disaster was regarded as a public misfortune. It must indeed be recognized that the spires of o our churches of the middle ages excite in the multitude a very vivid and sincere admiration. The boldness of these tall pyramids, that seem to lost themselves in the sky, their happy outlines, always make a strong impression on the multitude, s sensitive with us to all that indicates an effort of intelligence, the idea expressed with energy. The French provinces that first cooperated and executed these structures designed to indicate afar the communes and their power. The example th thus given by them after the 12 th century was followed in Germany, and England during the 13 th, 14 th and 15 th centuries; but whatever the boldness and lightness of the spires of Freiberg in Breisgau, Salisbury in England, Vienna in Austria, it is far from these inspirations of the monuments of this kind that yet remain among us, always remarkable by sobriety in o ornament, by refined study of outline, and by perfect understanding of construction.

Our readers will probably find it opportune to give them he here that celebrated spire of S. Denis, that we have been able to study with great care in all its details, since the sad task of demolishing it was imposed on us. The spire of S. Denis is a subject of study the more interesting, because the architect has shown in that work a profound knowledge of the effects of perspective, of lights and shadows' that resting on a slender tower with bad foundations and built of weak materials, he knew how to erect a spire of 126.3 ft. with extreme lightness, so as not to crush its insufficient base;[1] that recognizing the weakness of the external facing of Suger's tower a and the slight bonding of the internal masonry, he skilfully transferred all the loads to the interior.

Note 1.p.434. Indeed, the impending fall of the spire of S. Denis must be attributed to the increased weight given to it during the restoration by the substitution of stone from S. Non for stone from Vergele, that originally composed the pyramid. It must also be stated, that the lower parts, the stories

of the tower had not been consolidated, but on the contrary were weakened by external repairs made to the footings, without strengthening the solid parts, much changed by time.

Here (5) is onh fourth of the plan of the lower part of the spire of S. Denis. At A are the internal surfaces of the tower of the 12 th century. The sides B of the octagon are supported by four trumpets. On that base the architect had erected an internal colonnade composed of monoliths intended to transfer all the load to the interior by their incompressibility. Four dormers C opened in the four sides of the octagon; the four angles D were occupied by pinnacles. This colonnade formed an internal gallery E, which was reached by a stairs placed in one of the four angles and replacing one of the pinnacles; it permitted the oversight and maintenance of the structure of the spire. One will also note that the last course of the tower, which bears the pinnacles, does not exactly follow the square given by the earlier structure, but advances in form of a projecting angle to make the corner more acute and an appearance of greater resistance; that the columns supporting the pinnacles make this acuteness still more felt, and that it approaches the equilateral trinagle by the manner in which they are p placed; thus the architect evidentln wished to accent strongly the angles, fearing with reason the cold and dry appearance of the square plan.

Let us examine the elevation of this spire (6). If the sunlight falls obliquely on one of these faces (which is well understood to be the most frequent case), if that light strikes this face from right to left, the angle A of the lower cornice being askew as indicated by the plan, will be colored by a h half tint, while the angle B will be in full light, and by t the stronger reason the faces C D of the pinnacles; the contrast of the half tint on this skew face C, of the pinnacle on the right will accent the light caught by the oblique face of the pyramid and by its face parallel to the observer, just as the shade spread over the oblique face of that pyramid will the more accent the vivid light caught by the skew face D of the pinnacle on the left. Thus has been avoided that one part of the edifice should be entirely in the shade, while the other part should be in the light, an arrangement producing a bad effect, making appear every pyramid or cone detached against

the sky.

Let us cast our eyes of the section of the spire of S. Denis (7) made on an axis passing through the middle of the dormers. The elongated gables of these dormers are vertical, but do not so appear in elevation; in perspective they necessarily appear more or less inclined, unless the observer be exactly in the plane of these gables. One sees how the colonnade is only a rigid shoring to transfer the load of the spire to the internal surface of the tower. The perspective sketch C indicates one of the angle pinnacles removed and its connection along the face of the spire. Because of the inclination of these faces, the little columns engaged in the construction and taken in its courses up to the level D, are detached above that and monolithic. The imposts E, the two courses of the cornice G H are engaged in the courses of the spire; one will note that the second course that is not parallel to the first G, but that it tends to open slightly the angle of the pyramid to catch more light. That second course H, returning along the face of the spire on the projection I forms the projection H′ bearing the rear face of the triangular pyramid of the pinnacle of a gutter casting its water through two gargoyles. At K we have sketched the plan of this pyramid, whose a apex is placed so that the three faces have a similar inclination. The play of these more or less inclined lines was most happy, skilfully breaking the rigid edges of the spire without preventing the eye from following them, and had something both bold and refined that was charming.

The architects of the 12 th century had given to stone spires a considerable importance, compared with the towers that served them as bases. The spire of the old tower of the cathedral of Chartres is 196.7 ft. in height, while the tower is but 137.8 ft. The spire of the church of S. Denis was 126.3 ft. high and the tower is 114.8 ft. The proportions given by the facade of the cathedral of Paris must cause the admission, that the spires would double the height of the towers. Gradually architects gave less importance to spires. (Art. Clocher, Figs. 63, 75). Those of the cathedral of Rheims would have had scarcely half the height of the towers, like those of the church of S. Nicaise of the same city. The spires of the cathedral of strasburg is short and slender compared with the dim-

dimensions of the tower; it was only completed about the middle of the 15 th century.

As a structure, that spire is the strangest conception that can be imagined. The effect produced however, is far from responding to the efforts of the intelligence required to draw a and erect it. Besides, there is every reason to believe, that it was not entirely executed as it was conceived, and it certainly lacks in its outlines very important appendages, that have never been finished. In the museum of the work of Notre Dame of Strasburg, there exists a curious drawing on vellum f from the end of the 14 th century, which gives us the horizontal projections of the project of the spire. This drawing was very skilfully made and indicates differences in detail between the project and the execution; however one can regard the spire of Strasburg as a conception of the 15 th century.

The cathedral has claimed to render accessible to all the apex of this spire, not by ladders or by a little internal st stairs, but by means of eight easy stairs combined with eight hips of the pyramid, and that lead to the last central stairs ascending to the very small upper platform, the summit of a lantery crowned by an extreme point. These eight stairs, the sides of the spire and the central stairs are merely a tracery structure, a sort of stone scaffolding combined with very extraordinary science in drawing, but very moderately executed, poor in style and finished well or badly with haste and parsimony.

We give (3) one eighth of a drawing of the spire of Strasburg after the sketch of the 14 th century. By means of four o open stairs winding in four great pinnacles placed at four angles of the tower, according to this drawing one should reach the gallery A at the base of the spire. Thence passing across the opening one enters the stairs at B forming the eight ridges; ascending two steps, he should find a landing, then the first step of the winders at C. The slope of the stairs being naturally very steep, to reach the first landing D of t the lantern are required a very considerable number of steps. The architect then had the ingenious idea of placing 6 hexagons intersecting each other, thus presenting a series of entirely open turrets, in which the steps wind around newels in one direction or the other, allowing rapid ascent to a great

height within the very short space. Reaching the landing D ((always according to the original project), one took the great screw stairs E, probably double, that must rise to a second platform, from which by a stairs of smaller diameter he ascended to the upper lantern. The space G remained open and through lunettes opened in the vaults of the tower, allowed the pavement of the church to be seen. This was a conception of p prodigious boldness. In execution this project was modified a little (see sketch X). The hexagonal turrets were built; but reaching finally the last of each angle at H, one passed behind the half turret I to ascend to K, and thus at each bay. A person ascending by the angle turrets L thus reaches the platform of the lantern at K. There is found a central screw stairs as in the project, except that the enclosure of this stairs is octagonal outside instead of being square. As for the sides M of the pyramid, they are built of horizontal courses, like the spires presented at the beginning of this Article, but a are composed of great open tracery between the angles as indicated by the sketch P, and separated by lintels Q that serve as struts between these heavily loaded ribs, since they carry the verticals of the turrets. According to the project the a-angles B of the square lantern were each supported on the two ribs O, as if by two stone struts. The four great pinnacles receiving the four stairs reaching the platform A, and the h hexagonal turrets of the angle stairs of the spire, had been combined to be terminated by tracery pyramids, which would h have produced a surprising outline with great effect. Resources were probably wanting, and all these terminations became square, that at a distance produced a series of colossal steps with a deplorable effect.

It is understood that the spire of the cathedral of Strasburg is a masterpiece, and we do not pretend to deny it; but this very general admiration is particularly caused by the excessive height of the edifice. For us architects, whose admiration does not increase with the height of monuments, we m must regard the spire of Strasburg as one of the most ingenious conceptions of Gothic art in its decline, but as a conception poorly executed. It is certainly not what the author of the design on vellum imagined, of which we have just given a fragment, he doubtless desired to obtain a rampant outline de-

delicately opened by means of a series of little pyramids intersected by those hexagons so skilfully joined together, and not a series of steps, that arrest the eye in the most disagreeable manner. Placing a square lantern on the octagonal pyramid of the spire, he claimed to accent the termination by a form contrasting with the obtuse angles of the base. He certainly should have crowned that lantern by a final octagonal and very acute pyramid, and not by that swelled little lantern that terminates the actual spire. But if about the middle of the 15 th century Gothic architects had become excellent geometers, shrewd jointers of masonrw, they had lost that exquisite feeling for form found in their predecessors. Their ingenious combinations, their pretense of excessive lightness, led them to heaviness by the multiplicity of the details and the complication of forms, whose sense can no longer be discerned. Particularly in the outlines appear these defects; s simple and comprehensible forms being the only ones which produce effect, when one comes tc detach an edifice from the sky. However, the examination of the working drawings of Strasburg allows something good to be divined, superior to what we see, and for the honor of the successors of Erwin of Steinbach, it is necessary to believe that money was wanting to them, as to all architects that have been charged with completing or continuing cathedrals durius the 14 th and 15 th centuries.

According to the project, the 6 hexagons forming the winding stairs, built of stone verticals connected by tracery and lintels, should terminate in small tracery pyramids, each intersected by two sides of the upper hexagon; so that only four faces of the six of those pyramids alone were visible as abutting the successive newels receiving the projecting angles of these hexagons. A perspective sketch (9) will render this original arraugement. Thus the superposed summits of the hexagonal turrets now finished square like a series of steps, gave by means of these pyramids a rampant line broken by pinnacles and statues. Further, the open construction of the turrets entirely composed of verticals, and that are only joined together by the aid or iron, could be perfectly abutted by these pyramids that act as struts. That was a logical construction, c conformed to the requirements of the architecture of that epoch, which did not accept horizontal rests, particularly at

the tops of edifices.

By examination of the plan (Fig. 8) it does not appear that the architect author of the project desired to establish betw- een the angles tracery composed of slabs of tracery in the f form of faces of the pyramid; he needed the more resistant con- struction to support the great upper lantern, the construction indicated by the solid piers S. Yet one cannot admit that these piers were inclined like the faces of the pyramid; which would have produced a very bad effect. We should rather see in these piers the springings of arches of very low rise, but in a ver- tical plane and receiving tracery gables, that by the effect of perspective surmount the tracery terminations T. Besides, in the existing spire the architect established at the level of the third bay at N horizontal passages connecting the eig- ht stairs; these passages are borne on lintels and form the second termination, that intersects the spire in a bad manner. We do not admit that these passages were foreseen by the aut- hor of the project, but that their horizontal form was interr- upted by the outlines of the gables passing before them; an arrangement explained by our Fig. 9. The foot of the pyramid being strongly maintained by piers S, it could be constructed above the arches V by means of stone framework between the h hips, according to the definite execution. Perhaps one may t think that we lend to the architect author of the project of the spire of Strasburg, ideas that he never had, but one only lends to the rich. The art of architecture, particularly in epochs when it was necessary to employ enormous sums to execu- te ideas, can be judged with difficulty by what time has left to us. Most frequently the happiest conceptions, the best st- udied and rendered in an incomplete manner for lack of resour- ces, or have been mutilated by time and unfortunate restorat- ions. It is the misfortune of this art, not to be able to tr- ansmit its conceptions in their purity. Having presented the existing spire of the cathedral of Strasburg as a delicate work of mediocre execution, we shall not be blamed for having at t the same time sought to emphasize the qualities of the primit- ive conception, for having restored the merit to the artist, since we have shown ourselves severe toward a work evidently incomplete. Many other bad constructions have destroyed the u unity of conception of the western facade of Notre Dame of St

Strasburg; the central belfry between the two towers is a monstrous addition, that absolutely changes the proportions of this facade, a useless addition that must greatly torment the Steinbachs in their tomb, if indeed architects in the other world know of the changes that their works suffer, which would for us without exception be a continued torment.

If the architects of the 15 th century had possessed the resources at the disposal of those of the beginning of the 13 th century for the construction of great cathedrals, they would have left us stone spires, marvellous in their combinations, for the architecture of that time lent itself more than any o other to those sports in stonecutting. Yet it is doubtful that those monuments could produce more effect tnan our stone spires of the 12 th and 13 th centuries, sober in details but of perfect elegance in outlines, and permanently more solid and durable. The royal domain is the true native land of spires; there must one study the principles that directed our architects of the lay school at its origin. Normandy erected during the 13 th century a great number of spires that still exist, thanks to the goodness of the materials of that province; but these conceptions are far from equaling those of Ile-de-France. The spires of the abbey.aux.hommes of Caen, of the cathedrals of Coutances and of Bayeux, do not presnt us with a perfect harmony of the details witn the entirety; their pinnacles are mean, confused, covered by members too small for the places t that they occupy; the outlines are soft and undecided, never having that virile energy that charms us in the contours of t the spirer of Chartres, S. Denis, Senlis, Vernouillet and Etampes.

FLECHES DE CHARPENTERIE. Wooden Spires.

It would be difficult for us to state at what epoch date the first spires constructed of wood. They existed in the 12 th c century, since mention was then made of the burning of wooden towers; but we have very vague statements of their form. Those spires then probably consisted of great pyramids placed on s square towers, covered by slates or lead and pierced by dormers more or less monumental. Further, it is necessary to properly define what should be understood by a wooden spire. In t the north of France many stone towers were, and are covered by hip roofs of wood, that properly speaking are only very ac-

acute roofs. The wooden spire is a separate and complete work, that possesses its substructure, its stories and its roof; it is true that it can be placed on a tower of masonry, as were the spires of the cathedral of Amiens before the 16 th century, that of Beauvais before the fall of the transept, that of Notre Dame of Rouen before the fire, and still is that of the cathedral of Evreux; yet it is always characterized by a particular arrangement belonging to it; it is entirely a structure of wood placed on an edifice of stone, that serves it as a s support, like the modern domes of S. Peter, Val-de-Grace, Invalides, distinch monuments, independent of the mass of the structures that bear them. These works of carpentry are the o only ones that merit the name of spires. One might believe t that the spires of the middle ages of each epoch must have b been quite rare, because of fires, neglect of maintenance and time; still must of the great number were erected after the end of the 12 th century, that we still possess some, and that precious information remains to us concerning many.

All leads to the belief that the plan of the great churches and of the cathedrals in particular from the beginning of the 13 th century were conceived with the idea of erecting a square tower on the four piers of the crossing. Several of our g great cathedrals have had or still possess those square towers. Amiens, Rheims, Beauvais have had their masonry tower over the middle of the transverse aisle, Rouen, Laon, Bayeux, Evreux, Coutances, have retained entirely or in part. But either many were lacking, or architects may have recoiled from the danger of loading too heavily the isolated piers of the transepts, nearly everywhere those towers were not completed or were crowned by wooden spires covered by lead, which in spite of their considerable weight, were far from loading as much the lower parts, as a stone structure would have done. Y Yet some cathedrals do not appear to have ever received masonry towers over the crossing. Paris, Chartres, Soissons, present no traces, no more than Senlis, Meaux and Bourges, because these last monuments were conceived without transepts. Without masonry towers over crossings of churches, men had the idea of erectiug great towers of carpentry combined with the roofs. Notre Dame of Paris possessed a wooden spire covered with lead, which dated from the beginning of the 13 th century. That spire

was demolished about 50 years ago, and certainly was the oldest of all those existing at that epoch; its body still remained entire at the intersection of the roofs, even at the last. Now of spires of carpentry, the most important part that demands most study and care is the base. So we have accurately drawn this remnant of the old central tower of Notre Dame of Paris, before removing it to substitute for it the new carpentry, wh which further is established according to the primitive system.

See in what this consists (10); A B, A B, being the 4 piers of the transepts and C D the ridges of the two roofs intersecting at a right angle; the spire above the roofs is established on an octagonal plan, its angles being placed on the ridges of the two roofs and in the four valleys. The octagonal base is supported by two diagonal trusses A A, B B, intersecting w with a single kingpost G, which is the vertical axis of the spire; further, the four angles I are maintained in the vertical planes A A, B B, by means of great braces I A, I B. These struts meet at K and thus form the principals of the 4 inclined trusses K A B, whose apexes K support the 4 angles L of the octagon. By these means the 8 angles of the octagon are directly supported by the trusses, and the swaying of the entire system is stopped by the intersecting struts I A, I B.

It is necessary to know that this very elevated carpentry a always fails by the twisting moment produced near the base of the ridge. In fact the timbers being unable to change, they cannot shrink; the effect of wend and the weight ends by stressing the weaker point more than others; the entire effect i is then produced at that point, and the movement of rotation occurs that breaks the joints, curves the timbers, leads to the ruin of the carpentry. The system adopted for the base of the spire of Notre Dame has the result of causing, that not only is torsion of the base made impossible by the intersection of the braces, but also that each angle of the octagon tr transfers its load to two or even three piers. The angles L rest on the two piers A B, and the points I on three piers A B B or B A A . This system thus has again the advantage, that when the pressure of the wind acts on one side, always at least two piers of the transepts receive the additional load p produced by that pressure.

Now that this system is known, let us examine the application

of it at Notre Dame of Paris. The piers of the transepts of the cathedral do not form a square, but the quite irregular q quadrilateral, which adds to the difficulty of establishing carpentry resting on only four points of supporting a pyramid with octagonal base. Fig. 11 gives the horizontal projection of the base of that spire, assuming the section made above the ridges of the roofs; the timbers A B are the great struts that bear both the posts C at their intesections and the posts D, which at the same time they abut. These struts A B are kept r rigid by strong double ties E G, fixed by wooden keys; so that the two triangles C E G are inclined trusses for which the po posts C H serve as kingposts. Two great diagonal trusses I K directly support four angles of the octagon.

We give (12) one of these great diagonal trusses composed of a strengthened tiebeam resting on the low masonry wall and relieved by strong braces, whose foot A rests on the heads of t the piers below that masonry wall; of two principals C D and of bent sub-principals E F, framed into a central kingpost as the axis of the spire. The great braces A are also doubled. The principal posts forming the octagon of the spire are tripled from H to I, i.e., are composed of a middle and two outer timbers. The posts of the buttresses K;L are single and a are halved into the principals C D. One will note that these posts are strongly inclined toward the principal axis. The b buttress posts K L were originally abutted by great struts M L, that were over the valleys and presented a projecting s side, formerly decorated by pendant double ties O P covered by lead and accompanied by perforated timbers, whose remains R have been found. The post S, that was combined with that de decoration and remained in place, formed the head of this system of shores, visible above the four valleys. A capital V c carved on the middle kingpost gave the exact date of this spire (beginning of the 13 th century).[1] At a very early epoch these visible and decorated shores placed in the valleys, so necessary to the stability of the spire, had been removed, p (probably because they had been altered by time, not having b been cared for); this must have contributed to weaken the principals, which then must transfer the entire load to the posts K L.

Note 1.p.442. This capital was preserved at the removal of the spire.

Fig. 13 gives the framing at the level T, and Fig. 14 is that at the level X.

Fig. 15 permits one to see the arrangement of the great struts A B of the plan, Fig. 11. It is seen how these struts support at their intersections G the posts C H, how they are framed at the heads into the posts D K at D, how the horizontal double ties E F hold both these struts and the lower end of the post C H, also how the triangle G E F presents the system of an inclined truss resisting the load of the post C H. If we resume Fig. 11, we note that not only the posts forming t the eight angles of the spire are inclined toward the central axis so as to form the pyramid and not a prism, but that these posts give a double system of supports. We do not speak of the doubled timbers that triple some of these posts, because these are only furrings suited to give more stiffness to the posts and support in the direction of their thickness, and are especially intended to receive lateral framing, so as not to weaken the principal posts by mortises. This system of twin posts separated by a space is a very powerful means of resisting the pressure of the wind. It is seen that these posts are well connected together by doubled horizontal timbers at certain distances, and offer extremely rigid points of support. Indeed 1 let (16) two posts A B, C D, be fixed between the doubled timbers E F G; for the post C D to bend according to the line C I D, it is necessary for the post A B to contract, which is not possible; for it to curve according to the line C K D, it is necessahy for the post A B to lengthen, which is also impossible. The quadrilateral A B C D connected by the timbers E F G is thus not capableof deformation. Thus, faithful to th- this elementary principle, the Gothic architects have never failed to apply it in the construction of their carpentry spires, and as always have made of it an ornamental motive.

The base of the spire of Notre Dame of Paris however presents weak points, although it was combined in an ingenious manner, and that the system of carpentry was very good; thus the great diagonal trusses (Fig. 12) were not sufficiently ironed at the feet, the double struts A G did not perfectly abut the external posts of the pyramid, the principals were weak; and the tiebeams were raised and without strength. The trusses of the roof (those resting on the great struts, arranged as X-bra-

X-braces, Fig. 15) did not find an immovable point of support at the junction of these great struts, because of their great length and could bend, which occurred at the side opposite t the wind. consequently the entire spire must be inclined and strain its joints. Generally the lower timbers were not sufficiently large; also for carpentry subject to hurricanes, the wooden keys are evidently insufficient, especially when in time these timbers dry and no longer fill the gains in which they are inserted. Hench while respecting the principle on which this carpentry had been framed, one must in the reconstruction of the spire of Notre Dame of Paris improve the entire system, and introduce the improvements furnished by modern i industry. One forms with difficulty the idea before having tested it, of the force of the wind on carpentry placed at a great height on four feet only, that rises in the air above the other edifices of the city.[1] The pressure of air currents is such, that at certain moments the entire weight of the carpentry falls at the side opposite the direction of the wind; thus it is necessary to have complete stability in all parts of the system, so that this pressure cannot in any case throw the entire weight on one point of support. One must think that this carpentry is like one arm of a lever, that if not maintained by an immovable support will not fail to crush or dislocate one of the four piers that serve it as a support, the more that in our climate the great winds always come from the same point of the rorizon, from the northwest or southwest. This pressure being repeated on one side of the carpentry must be the subject of thought for the constructor. Starting from the system accepted by the architect of the 13 th century, it has then been sought:- 1, to form at the base of the new spire four feet absolutely rigid and able to resist all vibration; 2, to connect these four feet with the spire itself in such a strong manner, that all pressure acting in one sense is transferred to at least two piints of support and even to three; 3, to support equally the eight angles of the pyramid, while in the old system, four of those angles were supported better than the other four; 4, to double from top to bottom the entire system of framing the octagon of the spire, so as to avoid not only rigid hips, but even the faces; 5, to avoid joints by mortises and tenons, that are strained by the effect of vi-

vibrations, and to replace them by by the system of doubled timbers that do not weaken the timbers, connect them and give them a considerable resistance; 6, to only employ iron bolts, so as to leave the carpentry its elasticity; 7, to reduce the weight upwards by employing smaller timbers, but at the same time increasing the force of resistance by the combination of the carpentry.[1]

Note 1.p.452. The apex of the spire of Notre Dame of Paris is 315 ft. above the pavement of the church.

Note 1.p.453. On Feb. 26, 1860, a gust of wind that overthrew in Paris a great number of chimneys, carried off roofs and threw down some wooden triangulation stations, only caused the spire of Notre Dame to vibrate about 0.08 inch at its top, although then that spire was not entirely completed, and it was only covered by lead on its upper part, which must make the v vibration more sensible.

We have just stated:- the four transept piers on which rests the spire of Notre Dame of Paris are not placed at the angles of a square, but of a quadrilateral with unequal sides, which a added to the difficulty. To not complicate the Figs., we do not take into account here small irregularities, and we assume the parallelogram with larger sides of 43.39 ft., and smaller ones of 41.83 ft. Four diagonals of the octagon of the spire must necessarily rest on the two diagonals of the quadrilateral, this octagon is irregular, having four sides larger than the other four. Fig. 17 gives at A the plan of the bottom framing at the level of the great diagonal tiebeams, which are each composed of three superposed timbers having 9.8 ins width at the kingpost. This drawing shows that in the horizontal projection the four feet on which rests the base of the system. These four feet are formed of a combination of braces under the tiebeams and of inclined trusses B C passing in the p planes of the truncated pyramid, whose base is the quadrilateral given by the piers, and the upper section by the plan of the framing at the level of the tiebeams. Each angle of the body of the spire is composed of three posts, that do not rise vertically, but form a very high pyramid with octagonal b base; i.e., in rising these posts approach the kingpost.

Let us now examine one of the great diagonal trusses D E. (18). One sees at A the three superposed tiebeams, stiffened

and maintained at first by the two braces B halved and forming an X, then by two strong doubled braces C D, that receive the inclined braces indicated at B C in the preceding Figure. The heads of these two doubled braces grip at E the feet of the t three posts of the angle of the spire. The central kingpost is at F. Great braces G H follow the valley given by the intersection of the roofs; consequently all above these braces is v visible. The braces I K are doubled and form a ridge in the valley, throwing the water to right and left by means of rafters, and allowing to be seen opened steps decorated by arches and surmounted by statues on the four posts. Other braces M N connect together the entire system and join the central kingpost at O. Further this half truss is maintained by double h horizontal timbers that join together its different parts, p prevent all dislocation and make this carpentry a stiff plane, immovable and not to be deformed. The sketch A A of Fig. 17 g gives us the plan of the framework at the level P of Fig. 18; the sketch A A A is that of the framework at the level R, and the sketch A′ is that of the framework at the base of the pyramid, that terminates the spire above the second open story. In the sketch A A of Fig. 17 is seen the arrangement of the rafters dividing the valley in two parts, permitting the passage of the four posts bearing the statues.

This system of vertical posts traversing the diagonal half trusses and forming a decoration above the valleys (a system that had been adopted by the constructors of the 13 th century) presents several advantages; it makes these half trusses actual half timber work aud perfectly rigid; it forms a series of kingposts that strengthens the principals, maintaining them in their vertical planes without loading the tiebeam in anyway. It also presents an ingenious decoration by explaining externally, how the spire rests on the four piers of the crossing, and also because it forms a transition between the masonry of the church and the body of the spire, which it serves as a b base, the flying buttress, so to speak. One sees at V (Fig. 18) how are decorated these steps of the great principals above the valleys. It is easy to understand how are supported the four angles of the octagon, that rest on the diagonals; as for the four angles falling on the ridges of the roofs, let us see the system adopted. At B B (Fig. 17) are erected strong

trusses resting on the low walls and the four piers of the transepts; on the middle of the tiebeams of these trusses rest the horizontal timbers L M strongly relieved at C by the inclined timbers B C. Above this point C rest the triple posts f forming the other four angles of the octagon; the point M supports only the feet of the braces intended to maintain the p posts in their plane.

Fig. 19 presents one of these trusses B B, which serves at the same time as a roof truss. At A is seen the end of a horizontal timber drawn as L M in Fig. 17; at A′ that end is seen in section on a b. There is no need of explanation to feel t that this end A cannot deflect. At B′ we have given the detail of the connections at B, and at C″ are those of the X-braces with the kingpost.

Now let us examine this system of the base in perspective. (20). At A are seen the great triple tiebeams of the diagonal trusses; at B the arrangement of the timbers forming inclined trusses, stiffening the base of the spire and bearing at C the four angles of the octagon; at D appear the fragments of the tiebeam of the truss given in the preceding Figure, with the half timber work maintaining the angle posts resting on C, E being the kingpost of that truss. Braces F relieve the posts C and transfer their loads to the four principal resisting points A; these braces have the advantage of preventing the entire system from swaying. Above X-braces G are doubled, and also transfer the loads to the posts C of the diagonal points of support. The timbers I and F replace with advantage the great inclined timbers of the old carpentry, that we have described above. This system is further tripled in the existing carpentry, and we see it reproduced in K L and K M; so that if an unusual pressure is produced at O, this pressure does not load the point C, but rather the feet I, and even gradually three of the piers of the transept by the arrangement of X-braces and the struts F. One will note that these X-braces are doubled, i.e., are connected with two of the three posts, that form each angle at the base of the spire. There ir then no possibility of vibrationin that carpentry; none of its parts can receive an extra load without transmitting it to two or even three of the four points of support on which it rests. Even assuming that one of the four piers of the transepts were

removed, the carpentry would remain standing and would transfer all its lads to the three remaining piers.

The system according to which was established the base of the spire of Notre Dame of Paris being well known, let us examine this spire above the ridges of the roofs, i.e., above t the level at which it begins to detach itself against the sky (21). A perspective view presents at the right side the spire without its ornamentation, and at the left side the decorated spire. At A is one of the four trusses corresponding to the diagonal trusses; one will observe the inclination of the posts forming the angles of this spire below the upper pyramid, that only commences at the level B. That inclination, including the successive recessions, is less than 2.62 ft. in a height of 49.2 ft.; yet by the effect of perspective one scarcely perceives the diminution of the body of the spire other than that produced by the recessions C. Further, if the eight angles of the octagon were made vertical, the body of the spire would appear larger under the upper pyramid than its base. The illusion of the eye here accords with the condition of stability; indeed these eight angles, that tend to approach the king-post as they rise, lead the eye to the pronounced pyramidal form of the termination, and at the same time transform the series of shores that maintains the central axis vertically. By the singular effect of the contrast of the vertical and inclined lines detached against the sky at a great height, if the pinnacles D crowning the angle posts were vertical, they would seem to spread outwards, when seen perpendicular to the line of sight. It is necessary, that in a monument so elevated and whose general form is so slender, all liner should incline toward the axis, if one desires that nothing in the entirety should oppose the outlines. We give at E the termination of the spire, whose crown F is 147.6 ft. above the ridge of the roof.

We have stated that the carpentry in rising is composed of timbers gradually lighter, but more strongly connected. Examining the framework sketched at G, one recognizes how much resistance it presents; this system is adopted for the four frames indicated at G and in elevation at A. This framework is composed of doubled timbers halved together as shown by detail I, intersecting at right angles and binding the kingpost,

four angle posts, and is stiffened by braces K so as to form a square; immediately below the second framework set diagonally to that and combined in the same manner produces in horizontal projection a star with eight points, that gives the section of the pyramid. Not only does this pyramid present great resistance, but it has the advantage of giving to the pyramid shadows always accented, that correct it to the eye and give it the more elegant appearance. When the pyramids and spires are also acute and are erected on a section simply octagonal, if the sun strikes one side, a part of the pyramid is entire- in the light and the other is in the shade; at a distance the light side is confused with the sky, and the dark side gives an inclined line, that is not balanced, so that the pyramid seems out of plumb. The great pinnacles with their crockets that always furnish dark and brilliant points entirely around the pyramid, at the light side as at the side opposed to the light, also contribute to prevent these illusions of the eye, which are produced by masses of shadows without light spots, opposed to masses of light without shadows. We cannot repeat too frequently; when the edifice or a part of the edifice is entirely detached against the sky, nothing is indifferent in the ma s or iu the details, the least carelessness in the adoption of ornament, in the trace of the outline, entirely deranges the harmony of the masses. It is necessary for all to be clear and easily understood, that the mouldings and ornaments be at the scale, that they do not oppose the outlines, and still that they are visible and appreciable.

The spire of Notre Dame of Paris is entirely built of oak from Champagne; all woodwork is covered by sheet lead, and t the ornaments are in hammered lead.[1]

Note 1.p.421. The carpentry of this spire was executed by M. Bellu, the leadwork by M M. Durand Bros. & Monduit. The whole, including ironwork, weighs about 551 tons. Each pier of the transepts can bear this weight without crushing. The twelve statues of the apostles and the four figures of the symbols of the evangelists, that decorate the four ridges in the valleys are in hammered copper, executed after models furnished by M. Geoffrey-Dechaume.

Then as now the opportunity for erecting carpentry spires of such importance did not often present itself. Lead was for-

formerly dearer than today, although its price may still be very high; on little churches of market towns, villages or po-poor abbeys, men only thought of covering with slates the carpentry spires. In that case it was necessary to adopt simple forms, to avoid large openings, and to protect well the timber from rain and the action of the sun.

We have already stated many times, that the architecture of the middle ages lends itself to the execution of works most modestly conceived as to that of the richest works; that alone will prove it a complete art. If architecture cam apply itself only to sumptuous edifices, and if finds itself deprived of i its resources when it is necessary to keep to what is strictly necessary, it is no longer an art, but a dress without reason, a matter of fashion or vanity.

We give (22) an example of those spores entirely covered by slates, erected like that of Notre Dame of Paris over the intersection of the roofs; this is the spire of the church of O Orbais, formerly dependent on an abbey. Excepting the ends of the kingposts, that have very simple lead caps, the entire c carpentry is covered by slates. At A is seen the half of one of the half timber shaft of the spire; C D is the principal of the roof. As always, that shaft is diminished, being 16.0 ft. at base and 15.3 ft. at top at the level of the base of the pyramid. That is octagonal and its angles are set on the middle of the frames as shown by the sketch B. The corner timbers E are relieved by struts G framed into the corner posts H, and on the angles F are placed four little pinnacles, visible on the perspective sketch. The body of the spire, the pyramid, the pinnacles and the dormers are covered by small thick slates nailed on oak battens. There are lead sheets in the valleys. That edifice, so simple, has such a charming effect because of these projections, and particularly because of the happy proportions of the whole; it dates from the 14 th century. The bell cage is independent of the carpentry of the spire, a and like that only rests on the four piers of the transepts.

One still sees over the crowning of the old abbey church of Eu the base of the spire in carpentry of the 15 th century, whose original arrangement merits being mentioned. This was a pyramid passing from the square to the octagonal plan in the height of the roof, so that the inclination of the sides con-

continued without break from the ridges of the roofs to the a apex of the spire. This system offers great stability.

Let (23) A B be two of the four points of support of the transepts, inclined trusses B C forming the faces of the pyramid with square base. The projection of the trusses of the r roofsis given by the triangle A B D; then the triangles A D C, B D C, are seen above the slope of the roofs; the brace A E p passes in the plane of the two principals A G, A P. The king-posts I C pass in the plane of the octagonal pyramid. At the level of the ridges of the roofs is placed a frame on an octagonal plan G F K, etc., tenoned into the inclined principals A P, A G, B C, etc. The elevation X of half the spire from B to I shows the projection of the roof in B′D′, the great inclined truss in B′C′, inclined in the plane B′O. The braces A E of the horizontal plan are seen in B′E′, and the first octagonal base at L, on which rest the actual hips of the spire. H Here the angles of the octagon do not correspond to the ridges of the four roofs and the four valleys, but indeed the middles of the sides of this octagon. At N are traced one of those diagonal braces A E, and the section E P is made at the middle of one of the four sides of the pyramid next the valleys; dormers R are opened on these four sides . A gallery S breaks the uniform appearance of the spire and serves for the watchmen. The framework at the base of that tower is traced at M. The framework Q is traced at Q′, the fourth and fifth frames being combined in the same fashion. At V′ the prespective sketch indicates the junction of the inclined timbers of the spire with the first octagonal frame La This spire has been removed to the level Q, but a painting of the 17 th century deposited in the church of Eu, presenting a very well executed view of the buildings of the abbey, gives us the rest of the spire and its system of decoration, that did not lack elegance.

Fig. 24 reproduces the elevation of the spire of Eu, covered by its lead work and its slate roofing, the lead work only being applied to the upper termination of the pyramid, the gallery, the dormers and the valleys.

At Evreux on the central tower of masonry, that surmounts the crossing of the cathedral, rises the spire of carpentry covered by lead, very much changed by successive restorations,

but which still presents very good outlines. It is entirely o open from the lantern to the ridge, and that lantern is in t the good style of the 15 th century. The defect of this termination is to be too slender for the masonry shaft; it is badly connected, and the too large number of openings also makes this defect appear more shocking.

One of the most beautiful spires of the 15 th century was that of the S. Chapelle of the palace, rebuilt recently by t the late Lassus after the old drawing preserved in the Imperial Library. This spire is engraved in the Monographie de la S. Chapelle published by M. Bance, with its details of carpentry and leadwork. We request our readers to refer to that work.

But at that epoch architects had already lost that delicate feeling for the outlines of edifices, and they overloaded their entireties with so many labored details, that the masses lost their grandeur. One no longer finds in the spire of S. Chapelle of the palace that inclination of the posts of the lower portion supporting the pyramid; these rise vertically o or nearly so, which makes the entirety heavier and prevents the work from leadiug directly from the ridge of the roof to the apex. The details are at too small a scale, appear confused, and injure the principal lines instead of accenting them. Still we also see on the transepts of the cathedral of Amiens a spire of the beginning of the 16 th century, in the execution of which the qualities mentioned above are developed with rare good fortune.

If the spire of the cathedral of Amiens is a work remarkable in itself, it is not so in relation to the proportions of the edifice; its base is slender, leaves the roof abruptly without transition; the entirety is mean, if one compares it to t the magistral grandeur of the monument. As for the combination of the carpentrw, it sins by the mass of timber and by the lack of simplicity. The carpenters, masters of work, Louis Gordon and Simon Taneau, had the idea of carrying the spire on a platform composed of horizontal crossed timbers made rigid by armed trusses to the number of 10; which produced at the base a mass of timber so great, that one can scarcely pass between the principals of the pendent keys. However well built are t these trusses, this system presents no direct supports, there is always deflection because of the shrinkage of timbers at

the connections, and consequently flexure. The evident intention of the masters was to establish the rigid floor on which they erected the spire independent of that floor, just as they would have done on the ground. There are then two things in the carpentry of the spire of Amiens; the lower platform of t the spire properly so called, which that platform is intended to support. That requirement accepted, those masters have done the best possible; but the principle is vicious.

Fig. 25 shows in perspective that platform, or rather that bottom framework. To make the Figure less confused, we have assumed the pendant keys to be removed. The ten trusses may be seen to intersect at the principal from which the pendant keys support the tiebeams at the span of each horizontal timber. Two great diagonal tiebeams rest on this suspended floor. As at Notre Dame of Paris, the octagon of the spire has its angles in the valleys and on the intersecting axes of the roofs.

If we take one of the trusses of the spire perpendicular to the sides of the square, we obtain Fig. 26. The kingpost or central axis is at A.[1] At B are traced in section the trusses with pendant keys and opposite is one of these trusses in the plane parallel to our projection. The posts C of the octagon are then supported on the relieved tiebeams of these trusses, as well as the principal braces D. As always, the kingpost is suspended by meetings of the braces. A first horizontal frame composed of doubled timbers is at E, a second at F, and a third at G a little above the ridge H of the roofs. It is the first and last framework which receives the first platform of the spire, so that the open work commences immediately at the level of this ridge; which contributes to give meagerness to the carpentry work, since above the solid mass of the roofs b begins without transition the system of isolated posts allowing the sky to be seen between them. However well connected a are the principals B, or well fastened are the pendant keys supporting the tiebeams, there are numerous causes of shrinkage or loosening, because of the great number of these pieces of wood; it results from this that the lower floor has settled somewhat, particularly at the side opposite the action of the western winds, for one will observe that here the loads on the posts are not distributed at several points as in the carpentry of Notre Dame of Paris, but alt directly at their feet.

Then always a part of this suspended floor is more loaded than the rest, since western winds are most frequent and most violent, especially at Amiens.

The entirety of the system is inclined toward the east, and a little alter the erection there had to be added on that side a long brace, that rests on a truss of the choir very solidly built. The diagonal trusses have little resistance (27); the tiebeam A rests on the lower floor, as seen in the prespective sketch (Fig. 25); but as an additional force the carpenters placed under this floor, that passes in the space B, framed triangles G, whose feet rest on the heads of the four transept piers in the haunches of the vault. These triangles are weakly connected to the system of diagonal trusses, and have tipped under the deflection of the floors. Besides the principal brace E of that half truss is the valley, i.e., it is set at t the line of intersection of the roofs, which gives a position too much inclined to have much strength. If as at Notre Dame of Paris, the carpenters had placed the brace g h above that valley, visible and connected to the triangle C by means of large double timbers m, they would have given to the diagonal trusses much greater resistance, forming great and rigid frames, all parts of which would have been stable.

One will note here, as at Notre Dame of Paris, the posts of the octagon are doubled and strongly inclined toward the axis of the spire. That is a rule from which the architects of the middle ages did not depart in the construction of this sort of edifices.

The outlines of the spire of Notre Dame of Amiens are happy; there is nothing wanting to this carpentry work, except to be on a smaller monument. Fig. 28 presents the elevation of this spire covered by its leadwork. Unfortunately the spire of Amiens has suffered mutilations; its termination was restored in barbarous fashion in the last (18 th) century, after a partial fire caused by lightning. The lead work was partly replaced at the beginning of the 17 th century, and at some places is extremely coarse, concealing the mouldings or the perforations in the woodwork.

The section of the pyramid does not give the octagon with straight sides, but with concave curved sides (see detail A), so as to obtain lines of light and shadow, as we have said

above, and to avoid the bad effect produced by pyramids with plane sides, when they are placed at a great height and lighted by the sun. Some original parts of the lead work are very remarkable.

In summary, if the spire of Notre Dame of Amiens is not an irreproachable work, it however merits study; besides it is the only one of those dimensions still existing in France. Including the lead, its weight is 551 tons. Its height above the ridge (level B) to the ball was 154 ft.; it is now only 147.6 ft. The timbers are of good quality, heart of oak. Formerly the lead work was painted and gilded; numerous traces of that decoration are to be seen.

We shall also cite among the carpentry spires covered by l lead those of Notre Dame of Chalons-sur-Marne, that are from the end of the 14 th century, are very simple but of very beautiful form, and that crown stone towers of the end of the 12 th century; that of the hip of the cathedral of Rheims, w which dates from the end of the 15 th century, and whose lead work is very well preserved. (Art. Plomberie).

FLEUR. Flower. (Art. Flore).

FLEURON. Cross-flower. Plant Ornament.

A plant form terminating certain members of Gothic architecture, such as pinnacler, gables, canopies, cusps, etc. It appears in architecture only in the 12 th century, i.e., at the moment when the lay school seeks the ornamentation of its edifices in the flora of the country. From Grecian antiquity the roofs of certain edifices were terminated by means of plant decorations, as one can recognize in examining the choragic monument of Lysicrates at Athens. Although in that case the termination was probably intended to support the tripod that recalled the victory of Lysicrates over his rivals, this was no less a crowning borrowed from the plant kingdom. The celebrated pine cone of bronze seen in the gardens of the Vatican is an actual ornament terminating a great antique monument. The idea is not new, and in that as in many other things, the Gothic architects followed a very ancient tradition transmitted to them by the masters of the Romanesque school.

But what is new and belongs to those Gothic architects is t

the particular character given to those terminations, their f frank appearance of plant forms. One sees well characterized cross flowers appear at the summits of the pinnacles and dormers of the old tower of the cathedral of Chartres (middle of 12 th century); at least these are the oldest that have remained to us. Although deteriorated by time, these cross flowers allow their primitive form to be seen. They abruptly leave the tops of the angles of these pinnacles without intermediate rings; they present (1) a combination of young leaves and buds ending in human heads. The sculpture is broad and coarse, as proper for such a height. The entire ornament is c cut in a single stone more than 3.3 ft. high.

Yet the study of plants soon leads architects to seek in t the various members of plants those, that lend themselves best to that form of termination; they observe that the pistils of flowers, for example, often give regular ornament, perfectly appropriate to the end and apex; they see that these pistils are habitually accompanied by a collar and appendages. Then they render these plant forms without seeking too much to servilely imitate nature; they seize on the character of power and vivacity, and compose terminals like this (2), which dates from the last years of the 12 th century, and comes from the lower gablets of the buttresses of the cathedral of Paris (north side). This simple form does not seem to them to present an outline sufficiently cut out, and those artists had recourse to nature, separating more the leaflets accompanying the pistil (3),[1] so as to obtain expansion; or indeed a little later (about 1220), they seek to imitate buds (4);[2] they dissect them and remove certain parts, as indicated by this crown A of truncated petioles, and disengage the principal s stem B; then they begin to combine with this vegetation geometrical forms, architectural mouldings without the ring imitated from the fruit. While carefully studying plants, the sculptors of the beginning of the 13 th century do not copy them servilely; they subject them to monumental arrangements, to t the scale of the architecture. From the imitation of the pistil of flowers, grains and buds, they soon come to the imitation of the developed leaf, but always subjecting that imitation to the decorative requirements suited to sculpture on stone (5).[1] They know how to unite the balance of the masses w

with the freedom of the plant.

Note 1.p.473. From, goblets of the buttresses of the towers of the cathedral of Paris.

Note 2.p.473. From the facade of the abbey church of Vezelay.

Note 1.p.474. From the cathedral of Troyes (about 1225).

From the beginning of the 13 th century, the stems of the ornament show square or octagonal sections; this stem is divided into four leaves in a single tier with the upper bud, or into two tiers. In the last case the leaves of the second row alternate with those of the first, so as to oppose the lines produced in perspective, to give more movement and more effect to those ornamental terminations, as indicated by Fig. 6, and to restore the vertical line by the contrast of shadows and lights. Frequently the endings of cross flowers are nothing m more than crockets, like those accompanying the rakes of gables or pinnacles (7).[1]

Note 1.p.475. From the cathedral of Amiens; facade (about 1230).

About the middle op the 13 th century cross flowers of great dimensions bear two rows of leaves. All the architectural members tending to rise, to make the vertical line dominate, it was necessary to give increasing importance to these terminations of the acute parts of edifices. The imitation of plants became more scrupulous, more refined, but also less monumental. This vegetation did not belong to the stone but was like an addition; it was no longer the stone that expanded, but indeed leaves surrounding a nucleus of geometrical form (8).[1] What cannot be too much admired in these terminals of gables and pinnacles is their just proportion to the architectural members, that they crown. There is an ease and grace, a delicacy of contour, a firmness in these terminations, very difficult for us to reproduce, accustomed as we are to the dry and common ornamentation of modern times. Yes, because of the false rendition of the antique sculpture, we tend to conventional ornament, symmetrical, dead and fossil, copied from copies; or we launch into the domains of caprice and fantasy, because for a century artists possessing more fancy than taste have o opened to us this dangerous path. Just as caprice is sometimes seductive, when it appears naturally and is a freak of the spirit, just so much is it wearisome if labored. The ornaments

furnished to us by this Article (ornaments of singular importance, since they serve as terminations of the dominant parts of edifices). are not the result of caprice, but indeed of t the attentive and refined study of plants. There is a Gothic flora with its laws of harmony, its reason for existence, so to speak, like the natural flora; it is found on bands, capitals, and particularly on these terminal'cross flowers, so visible and frequently detached agains the sky, whose outlines, relief and charm, can spoil a monument or give it an attractive appearance. The variety of cross flowers of the 13 th century is infinite, for although our edifices of that epoch may be covered by them, no two are known, sculptured from the same model. So we can present to our readers only a small number, selecting those distinguished by particular arrangement or by great perfection of execution.

Note 1.p.476. From the north portal of the cathedral of Paris (1260).

In the edifices of Ile-de-France and of Champagne, these cross flowers are incomparably more beautiful and varied than in the other provinces; they are also better proportioned, mo more broadly designed and executed. Those in great number to be seen around the cathedral of Paris, those of the tomb of Dagobert at S. Denis, those of the church af Poissy (9) that terminate the flying buttresses of the choir, those of the cathedral of Rheims (we are speaking of the old ones) are for the most part in a good style and executed by the hand of a master.

Around the upper balustrades of Notre Dame of Paris can be seen cross flowers on square bases and terminating the pilasters, that have an incomparable breadth of style (Art. Balustrade, Fig. 10). Those of the external balustrade of the gallery of the choir, whose fragments we collected, had a character of power and energy, that one finds expressed to the same degree in no other monument of that epoch. (Beginning of the 13 th century). (10).

About the end of the 13 th century these ornaments became more leafy, servilely imitating the flora, then adopting forms all especially borrowed from the excrescences of the oak leaf (gall nuts) and water leaf. This transition is sensible in the church of S. Urbain of Troyes, erected during the last

years of the 13 th century. The great cross flowers with three rows of leaves, that terminate the gables of windows, are carved with boldness and ease that reaches exaggeration (11).

During the 14 th century cross flowers are usually composed only of the combination of four or eight crockets following t the forms given to this ornament. The decoration at that epoch becomes monotonous like the lines of the architecture. Yet t the cross flowers are sculptured with remarkable spirit and life (12). One sees quite beautiful cross flowers at the cathedral of Amiens, around that of Paris, at S. Ouen of Rouen, S. Etienne of Auxerre, the cathedral of Clermont, S. Just of Narbonne, and S. Nazaire of Carcassonne; but the great defect of the sculpture of the 14 th century is the lack of variety, and this defect is particularly offensive, when concerning t the terminations, all viewed under nearly the same conditions.

In the 15 th century the cross flowers terminating the pinnacles or gables are often despoiled of foliage and are simple terminations of geometrical forms in the style of Fig. 13. Y Yet if the edifice be very richly sculptured, for example like around the choir of the abbey church of Eu, these terminations are covered by water leaves or rather by ornament strongly resembling marine algae (14). About 1500, cross flowers are nothing but a combination of the crockets of the rakes of gables or pinnacles, and they end in a long prismatic stem. (Arts. Contre-Courbe, Fig. 2; Crocket; Fenetre, Fig. 42; Gable; Pinacle).

The same name (fleuron) is given to the expansions of leaves terminating cusps. (Art. Redent).

Whether the cross flowers belong to the 13 th or the 15 th centuries, they are always well placed, boldly outlined, in p perfect proportion to the parts of the architecture that they surmount. Gothic architects knew how to crown their edifices. One must the more be devoted to these qualities, because today most of our modern monuments evidently sin by the contrary defect. The classical era, which has ended, regarded these terminations as the excess of bad taste. The Greeks and Romans h however did not fail to terminate the upper parts of their edifices by ornaments in stone, marble or metal, that were detached against the sky; but the examples no longer exist in p place, and it was agreed that antique architecture could do

without those accessories. That was a means of eluding the difficulty. But gradually archaeologists, examination of the scattered fragments and medals, have made it recognized that the ancients were far from depriving themselves of these ornamental resources; thus men seek timidly and rather by chance to break the dry and cold lines of our palaces, our public e edifices; now when it concerns outlines, what are necessary are bold lines, a sure eye, experience anf perspective effect, observation of the play of shadows. That experience must be acquired, for we have absolutely lost it.

FLORE. Flora.

We have frequently had occasion to speak of the sculptured flora of the architecture of the middle ages; that is indeed because that architecture possesser its flora, that is modified as the art advancer and declines. During the Romanesque period, the flora is merely an imitation of the Roman and Byzantine sculpture; yet one perceives about the beginning of the 12 th century in certain Roman edifices a manifest tendency to seek models of sculptured ornamentation among the plants of t the forests and fields. But how did that search commence? To what elements was it attached at first? What originated it? How was it erected into a system, and succeeded in forming a school? To solve these questions is to form a history of our French art at the moment when it develops, when it is really original and borrows nothiug from the past.

In examiniug the monuments, it seems that the Cluniacs were the first to form schools of sculpturs, that sought in natural productions the elements of their decoration. The capitals of the nave of the abbey church of Vezelay are already no longer debased imitations of antique sculpture; their sculptured vegetation possesses an appearance suited to it, which has r ruggedness in the new art rather than the barbarous impression of an art, the last reflection of aged traditions. On the banks of the Loire and Garonne, in Poitou and Saintonge, at the beginning of the 12 th century, sculpture is seen to seek elements other than those left by antiquity. These experiments are however partial; they appear to belong to isolated artists, wearied by always reproducing types, whose sense they no longer undeestood, because they knew not their origin. How-

However this may be, those experiments have a certain importance; they opened the way for the new school of lay architects; this is at least probable.

We present at first one of those examples, that will emphasize in the clearest manner what we are going to say. We give here the capital from the abbey church of Bourg-Dieu near Chateauroux, whose sculpture dates from about 1130. (1).

Here are seen leaves of fern at the moment when they begin to expand, to leave their downy tissue. We believe there is no need to cause to be noted in this capital the evident intention of the artist; he certainly desired to use these strong forms given by those sprays of fern, that are found everywhere in France under the great trees. The sculptor is inspired by neither Roman traditions nor Byzantine ornaments; he has gathered the sprig of fern, has examined it carefully, is moved by a passion for those charming natural productions, and then he has composed his capital. Let us in our turn note this Fig. 2; we shall have occasion to return to it. This is for that epoch, we repeat, an isolated fact. But soon the lay school of architects arises, takes possession of all constructions, particularly in the royal domain. From its first steps, one feels that this school desires to break with the traditions of art and of the works. Perhaps there was ingratitude in that procedure, since this school was raised beneath the vaults of the cloisters, but that is of little importance to us today. As a system of construction (Arts. Cathedrale; Construction), as a method of building, the lay architects of the second half of the 12 th century seek to break with monastic traditions. The forms they adopt, the mouldings they drew, the profiles they cut, and the ornaments they carve, are based on principles foreign to Roman art; observation and research replace the tradition. When it concerns ornaments, they no longer wish to consider old capitals of Romanesque friezes; they go into the forests and the fields, they seek the smallest plants under the grass; they examine their sprays, buds, flowers and fruits, and see them with this humble flora compose an i infinite variety of ornaments with a grandeur of style and fo firm execution, that leaves very distant the best examples of Romanesque sculpture. Whether by instinct or reasoning, those a artists understand that the smallest plants, like insects, are

endowed with organs relatively much stronger than those of gr-great animals; destined to live in the same locality, to resist the same agents, foreseeiug nature indeed has given to its humblest creations a strength relativelw superior to that of the great beings. The forms of the smallest insects, like those of the smallest plants, have energy, a purity of lines, a vigor of organization, that lends itself marvellously to express grandeur and force; while on the contrary one notes, particularly in the forms of great plants a sort of indecision and weakness, that cannot supply examples of monumental sculpture. Besides, who knows? Those lay artists who arose in France at the end of the 12 th century, and that rose in the midst of a badly constituted society, those artists scarcely understood in their time and very little today, perhaps found a certain charm in surrounding their art with mystery; just as they transmitted their great principles in the shadow of a sort of freemasonry, and also in seeking their ornamental motives along the banks of brooks, in the meadows and the depth of forests, in the lowest plant productions, allowed themselves to be guided by that instinct of the poet, who does not desire to show common men the secrets of his conceptions. True art has its modesty; it conceals its fertile loves from sight. Who knows if those artists did not find intimate joy in the monumental reproduction of those humble plants, known to and loved by th-them alone, gathered and long studied in the silence of the forest? These reflections came to us frequently in examining the marvellous developments of plants lost in the grass, their efforts to repel the ground, the vital strength of their sprays, the energetic lines of their growing shoots, the forms of the beautiful ornaments of the first Gothic period returned to our memory. Since we are going to seek the elements of an art in those lowest productions, upon which nature seems to have cast one of her mildest looks, why have not others before us have done this also? Why have not observing artists, wearied by the monotony of Romanesque art, been charmed by this modest flor of the fields, and seeking an art, why have they not said on discovering these concealed treasures; "I have found it?" Once in that path, we have followed step by step and not without a lively interest the ingenious interpretations of our predecessors; our examination has led us to singular results. We

We recognized that the first artists (it is understood that we speak here only of the lay school, that arose from 1140 to 1180 in Ile-de-France and adjacent provinces) were led to imitate the appearance of those modest plants of the fields at' the moment that they developed, when the leaves scarcely leave their shoots, the buds appear or the thick stems filled with sap have attaimed their growth; that they have been to s seek as motives of ornaments embryos, or again pistils, berries, and even the stamens of flowers. With these elements they composed those great capitals, that we admire around the choir of Notre Dame of Paris, in church S. Julien-le-Pauvre, that of S. Quiriace of Provins, Sens and Senlis, of S. Leu of Esserent, in the choir of Vezelay, the church of Montreale, at Notre Dame of Chalons-sur-Marne, and around the sanctuary of S. Remy of Rheims. Soon (for we know that those artists do not stop in the way) from imitation of the growing flora they pass to the imitation of the developed flora; the stems lengthen and become smaller; the leaves open and spread; the buds become f flowers and fruits. Later those artists forget their humble primitive models; they seek their examples on the shrubs; they take possession of the ivy, vine, holly, mallow, sweetbrier and maple. At the end of the 13 th century they copy servilely the oak, wild plum, fig, pear, as well as the leaves of t the waterleaf, bindweed, parsley, and herbaceous plants, as w well as the foliage of the great trees of our forests; all is good to them, all is for them a motive of ornament. Let us say at once, that the imitation approaches more nearly the reality as Gothic art advances toward its decadence. At the end of the 12 th century and also at the beginning of the 13 th, this imitation is subject to monumental requirements, that lend to the sculpture a special beauty. Let us also state that this sculpture is greater, broader, more powerful and finally monumental, when it seeks its inspirations among the most modest plants; while it falls into dryness and leanness when it desires to copy the leaves of great plants.

The lay artists of the 1? th centurw in using these plants seized on their principal charcaters and appearance; these b became for them the subject of inspiration rather than an ordinary model. But let us take some examples. For example, it is evident that the scrolls which decorate one side of the m

mullion of the middle portal of the cathedral of Sens (about 1170) were inspired by those young sprays of fern, some sprigs of which we have given above, and those of the shooting leaves of plantain (3), have they inspired artists who sculptured t the capitals of the choir of Vezelay, those of the gallery of the choir of Notre Dame of Paris (3 bis), or those of the church of Contreal (4)? Is there not a great analogy between th those little scarcely developed flowers of coronilla (5) and the primitive crockets decorating the angles of those capitals? The section of one of those plantain leaves (Fig. 3) made on a b and sketched at A, is faithfully observed in the sculptures given here.

Before carrying farther the examination of the monumental flora of the lay school, it is necessary to render an exact account of the mixture made during the Romanesque period, of antique traditions with certain forms evidently inspired by some plants of our forests. Writers have already stated very ingenious observations on this subject, however without strengthening these observations by studied Figs.; some claim that the ornaments, that in the 12 th century came to form what is called the fleur-de-lis, were inspired by the iris or gladiola; others that those carved and painted ornaments, so common from the end of the 11 th century, are a reminiscence of arum plants. We leave to all to judge of the process, and we shall l limit ourselves to supplying the examples; thus indeed in our opinion, it matters little whether the sculptors of the 11 th and 12 th centuries copied the iris or the arum; the question is to know whether those sculptors have added something to the worn-out traditions of the Romanesque arts in their ornamentation. The fact does not seem doubtful.

Let us first take the Aracae, that appear to have inspired our sculptors from a very ancient epoch.

According to Jussieu, the Aracae are "plants with tuberous roots, with leaves simple, alternate, sheathing; flowers monoecious, joined with a true colored spathe, with or without a special perianth; fruit bacciform."

Arum maculatum, commonly known by the name of"gouet"or calfsfoot, bears an erect stem, nude, about 8 ins. high, smooth; leaves are radical and borne on long petioles, large, sagittate-cordiform, as if truncated obliquely at both sides at the

base, entire, without spots, smooth; the terminal spathe is elongated and pointed; the spadix is shorter that that; in r ripening, the part above the berry falls; there remain numerous berries, red and contain two rough seeds. The flowers (pathes) are light green and turn violet in fading. The arum appears in April and May, and is very common in damp forests of the vicinity of Paris, Champagne and Burgundy.

Since it is not certain that all architects may be botanists, we give here a representation of the arum. At A the spathe is closed; it still envelops the spadix. At B the entire plant is shown with its tuberous root; the spathe is developed, is opened and allows the spadix to be seen. The leaves are sagittate. At C is given a section of the spathe, permitting to be seen the entire spadix with its stamens and its pistils at t the base. When the fruit is ripe, D, the upper part of the s spadix is destroyed; the spathe remains in the state of a fragment, E. At F is one of the stamens. No person walking in t the forest in spring has not examined this plant of a remarkable appearance, already expanded when trees and shrubs bear som tender leaves scarcely out of the buds. The arum and the iris are the first signs of the return of fine weather. Is it for that the Romanesque sculptors seem to have loved these p plants, as the revival of nature? Is it necessary to attach t to the imitation of aracae a symbolic idea, to see in it an antique tradition? We shall refrain from deciding the question. The fact is that in the sculptures of the end of the 11 th c century, we find the evident trace of that imitation. The beautiful capitals of the nave of the abbey church of Vezelay s show us imitations of the aracae (7), which terminate foliage more or less derived from the Roman sculpture of the Corinthian c column. At A is developed the spathe of arum and the end of the spadix has fallen, the berries remaining visible. At B t the leaves of the arum are rolled in volutes or crockets at the angles of a capital. In Fig. 7 bis, the sculptor has doubled the spadix at A, but left it single at B; but in both cases the spathe encloses the fruit.

These plants of marshy forests do not seem to be the only ones that inspired Romanesque sculptors; we see that they have a particular affection for the water lily, and for the water leaf. Two other capitals of the nave of vezelay also present

in form of crockets withered leaves of water lilies, with or without flowers (8). One knows how rapidly water plants wither when gathered; in example A it appears that the sculptur, to decorate the angle of his capital, suspended near him the leaves of the water lilies so common in our ponds, and that they have closed together, as soon occurs when they cannot l longer extend on the surface of the water.

These imitations are very free, such as occur among primitive artists, but they scarcely appear doubtful. Indeed it is unnecessary to reproduce a certain plant with all the care of the naturalist, but to find a motive for ornament. Besides, the eyes of naive observers are satisfied by an interpretation, and daily we see children for whom a puppet roughly carved in a bit of wood is the complete image of a personage. Indeed it must also have recognized that style in the arts, for ornaments as well as for everything borrowed from nature, demands interpretation rather than scrupulous imitation of the object. Plants have a charm and appearance of pose, that strike the inexperienced observer at once. He seizes its general characters without going beyond that; he produces a second c creation that becomes a work of art, although one finds in t that second creation the powerful imprint of nature. Romanesque artists adhered to those primitive inspirations; they even corrupt them as their hands acquire skill, and it is interesting to see how, when the art becomes lay, the spirit of examination is promptly introduced into the sculpture of ornament; how free inspiration, or that subject to certain traditions of the profession, is soon suffocated by the desire of arriving at the servile imitation of nature.

Let us now say a word of the flower of the iris, that also enjoys a great part in the Romanesque ornamentation of the 11 th and 12 th centuries. The flower of iris is enveloped in a membraneous spathe before its expansion. According to Linnaeus, "the corolla has six deep divisions, alternately expanded and reflexed; the style is short, bearing three narrow petaloids, often emarginated, which takes the place of stigmas; the lower capsule has three valves, with three polyspermous cells."

Here (9) is an iris flower, known under the name of flag, drawn at natural size. If we present this flower so as to ma-

make its different parts regular, we obtain Fig. 10. The six divisions of the corolla are visible as A A, B B, C C. Two of the narrow petalloids are visible at D, the third being found on the axis of the flower. The spathe is at E. From this form of the ornament known under the name of fleur-de-lis is not far. In the Romanesque ornaments of the 12 th century (11,[1] 12 and 13 [2]) is recognised the attempts of artists seeking to inspire themselves by the general forms of the flower of the iris, while retaining the style of degenerate Roman art. Those artists especially love the arum and the iris; from the b beginning of the 12 th century, these two plants give a particular appearance to sculptured or painted ornamentation (Art. Peinture). What was the reason that caused the selection of t these plants of wet places, that flower in the first days of spring? M. Woillez, author of a very interesting pamphlet on this subject,[1] does not hesitate to see in that imitation of araceous plants a symbolical idea of power. He sees there a r relic of paganism, and expresses himself thus:- [2] "I think t that the arum, the actual type of the botanical family araceae, or another plant of the same kind,[3] became in some sense the phallus transfigured by Christianity. The simple rustic appellation of the plant in certain places in Picardy, and notably in the vicinity of Clermont, sufficed to suggest to me this o opinion. I knew that this plant, concealed beneath wet and sn shady forests, eccentric in its external forms, was in great credit among magicians and enchanters of the middle ages, when I learned its most common name. This appellation corresponds to the Latin words "presbiteri phallus;" the spadix enveloped by its green spathe is still called "vicar", while at the moment of fertilization and when this spadix has taken a violet tint, it is "priest". The arum may be called a plant phallus, and is one of the plants first announcing the return of vegetation, or like the phallus properly so called, the revival of nature; it indeed could be the expression or emblem of the imperishable generative power, since annually and without previous culture, one sees it pierce the earth, then disappear after fructification, to reappear after the succeeding winter. But further, like the phallus, it has figured as the attribute of power in general, which will prove its identity with that." M. Woillez recalls in connection the note of Dr. Colson [4] on

a medal of Julia Mammea, on the reverse of which is seen Juno holding a phallus in one hand and in the other a lily, and it is to be stated indeed, that the first sceptres borne by kings or even the Holy Virgin are terminated by the arum flower or lily flower quite similar to that we have given above (Fig. 1 10), only M. Woillez sees in these ornaments only imitations of the plants of the araceae. I think that one finds there b both the arum and the iris; even sometimes, as in ornament, (Fig. 13), the combination of the two spring plants. However it does not seem to us in the present state of actual knowledge, that one can give as assured facts the influence of those pagan traditions of high antiquity in the arts of the middle ages.

Note 1.p.495. Museum of Toulouse (frieze).

Note 2.p.495. Capitals deposited in the storerooms of the imperial church of S. Denis.

Note 1.p.497. Iconog.d.pl.aroides fig.au M.A. en Picardie, et cons. comme orig.d.l.fleur-de-lis de France. Amiens.1848.

Note 2.p.497. Page 41.

Note 3.p.497. As we have just shown, the iris served as a type for Romanesque sculptors.

Note 4.p.497. Mem.d.l.soc.d.antiq.d.Picardie. Vol.VIII.p.245.

If the sculptured Romanesque flora combined with the last r remains of Roman arts the new inspiretion aroused by the observation of the spring plants of the forests, it also suffered the influence of the arts of the East. During the 10 th, 11 th and 12 th centuries many articles brought frsm Byzantium and Syria filled the treasuries of the monasteries of Paris; fabrics, ivory carvings, utensils, furniture, came in great number from the East and supplied French artists with motives of ornaments that they interpreted in their own manner. Many of these Byzantine ornaments were themselves borrowed from the eastern flora. Then it should not be surprising to find on o our capitals and friezes of the 11 th and 12 th centuries forms recalling certain plants then unknown in the West. (Art. Sculpture).

Such were the different sources from which Romanesque sculptors had drawn, when there appeared the lay school of the second half of the 12 th century; this school could not break a abruptly with that preceding it. In the same edifice is seen

as at the cathedral of Paris, around the choir of the church of S. Leu of Esserent and at Noyon, sculpturs still impressed by Romanesque traditions beside ornaments in a style entirely foreign to those traditions, collected in the French flora. These are the leaves of columbine, aristolochia, primrose, b buttercup, plantain, toadflax, celandine, hepatica, cress, g geranium, sorrel, violet, rumex, fern and vine; the flowers of snapdragon, monkshood, pea, water lily, rue, broom, orchid, gourd, iris, saffron, lily of the valley; the flowers, fruits or pistils of the poppy, polygala, flax, mallow, some roses, marigold, euphorbia, alisma, iris and colchicum, which inspired the sculptors of ornament. But one should not mistake the value of our statement, for those artists were not botanists; if they seek to render the appearance of certain plants, they do not pride themselves on organic accuracy; they do not make the error of mixing species, of taking a bud from one plant, a leaf from another, a shoot from still another; they observe with scrupulous care the principal characters op the plants, the modeling of the leaves, the curvature and diminution of the twigs, the junctions, the pure aud firm contours of the pistils, fruits or flowers; they create a flora that belongs to them, but which however monumental it is, retains a character of likeness full of life and energy. That monumental flora has its laws, development and charm; it is an art in brief and not an imitation. We are today so far from the path pursued at all fine epochs, that some efforts are necessary for us to understand the power and that creation of the second order, as far distant from servile imitation and commonness as from pure fancy. Our monuments are covered by imitations of Roman ornamentation, which is only a mistaken copy of the monumental flora of the Greeks; we copy the copies of copies at great cost; our architectural ornamentation falls into vulgarity, while the lay school of the end of the 12 th century goes to the sources to seek its inspirations. Not only does it thus find an original ornamentation, but this is based on a principle ever new, always alive and applicable. French art of the great lay school of architecture is logical; in its construction it establishes new principles, that without imposing a f form, are applicable everywhere and in every time. In decoration, this art only established principles; it did not prescribe

the use of a hieratic form like oriental art. The genius of each artist can constantly derive from those fruitful principles new and unforeseen forms. In our days has been restored in France method, the declaration of principles by teaching, not by reasoning, of one or several forms, of art; one of the applications of the principle has been taken for the art itself, and then men said with much reason:- "All imitation is bad; if we prescribe the imitation of the arts of antiquity, we cannot prescribe the imitation of the arts of the middle ages." But replacing the teaching of such a form, of application of the principle, by teaching the principle itself, one does not prescribe imitation, but only employs a true method, that allows everyone to follow his inspirations. We know well that it is a school for which principles are an embarrassment; it desires fancy alone to be the sole guide of the artist. C Caprice has charming turns when it is only the polish of a re-reflective and observing mind, when it covers with a vestment with a thousand unforeseen reflections a solid body, well made and healthy; but nothing is more monotonous and wearying than caprice when it is alone and only covers an inconsistent, wretched and poor body. There is certainly much fancy in the architectural ornamentation of our French school. But it only plays around principles, substantial and true, derived from acute observation of nature; fancy is then only grace, that knows how to avoid pedantry. Let us pursue our study.

Here (14) is a very common plant, the cress. Then examine with attention those supple and fleshy stems, those petioles well joined, those graceful curves of the branches and their detail A. Yet in these branches is an indecision of contour, which does not lend itself to monumental decoration; the stipules B throw confusion into the midst of the masses. To make an ornament with this plant it is necessary to sacrifice something, to give firmness to the outlines of the petioles; it is necessary to take and to leave, to add and to omit; what it is necessary to retain is the accent and grace, flexibility and ease of the outlines. With incomparable skill, the sculptors of Notre Dame of Paris have attained that result (15).[1] While retaining the outlines of those leaves of cress, they have gi given them an accent, firm, monumental and precise; between these branches they have added clusters to give grandeur and

at the same time refinement of the ornament. They have seen and studied nature, and have derived from it a new creation. Here are no traditions of Roman or Byzantine ornaments; this is original, living and well comprised as in a composition executed with skill. This makes itself apparent, like every work in which art is based on nature without merely copying it.

Note 1.p.499. Western portal of the cathedral of Paris, first years of 13 th century.

Let us also examine this leaf of celandine (16), such a common plant in our fields; these leaves are deeply divided, with oval leaflets, toothed and with rounded lobes; their fibrous ribs are marked and thick; the lateral stipules are developed. It is a matter of interpreting this plant, beautiful by its general form and by its details. The same sculptors compose the ornament (17).[1] They recurve the upper leaflet on itself and double it by the second leaf to increase its mass. They note the two lateral stipules; they broaden properly the petiole; they retain those eyes, which give a particular character to the leaf of the celandine, those rounded lobes; they exaggerate the structure of this fibrous and strong rib; then in Fig. 16 the cross section of one of the stipules gives the sketch A; B being the bottom of the leaf, they adopt the section C in their sculpture. Always attentive to seize and accent the principal characters, that lend themselves to monumental ornamentation, they omit details whose reproduction dwarfs or weakens the sculpture. Without seeking absolute symmetry, still they avoid the uncertain irregularities of the plant. They compose the ornament with several members of plants, but they have sufficiently observed nature to give probability to their compositions. Many of these inspirations are monsters from the point of view of science, but these are monsters created as likely to live. We find again those same qualities in the sculptures of the 13 th century, when they compose fanciful animals. (Arts. Sculpture; Gargouille).

Note 1.p.502. From Notre Dame of Paris. This ornament is f found under the statues of the portal at the right of the buttresses; beginning of the 13 th century.

If those artists do not possess the science of the botanist, if they do not accurately copy a certain plant or portion of a plant, yet they have observed with delicacy certain organic

laws from which they do not wander; they know the anatomy of the plant and follow its general rules; thus the fibrous ribs, the skeleton of the leaf, is always arranged in a probable manner, the modeling of the leaf is delicately rendered, and as we have said above, by preference is inspired by those little plants, whose strength of organization is relatively more developed than in great ones, and with more characteristic f forms, simpler and firmer in style.

For example, in Fig. 18, that gives us at A leaves of the family of Sohrophulariacae,[1] the last leaf B is recurved when it has just left the bud; while this leaf from the Umbelliferae C, of natural size, is well divided, strong and broadly modeled. By the aid of these humble plants, our sculptures of the 13 th century have composed the frieze of monumental appearance, energetic and grand. The little leaf B supplied them with the motive of those crockets with projecting heads in F Fig. 19,[2] and the leaf from the Umbelliferae that cluster interposed between the stems of the crockets. On the western f facade of the cathedral of Paris,[3] the sculptur knew how to make the leaf of rumex (20) [4] a grand decoration (21) of incomparable breadth of modeling and purity of form. Sometimes from the flower (for flowers rarely lend themselves to monumental sculpture), they composed the ornament, that has nothing of the flower, unless it be a particular outline, and unusual swelling; but in the corollas, whose forms are almost always undecided, they substitute actual leaves very clearly characterized. Thus (22) from the flower of the snapdragon, different views of which we give at A, they have composed the head of a crocket B,[1] three members of which recall the leaf of t the hepatica (23). From these same flowers of snapdragon while still young, they have made extremely simple leaf crockets D, that are found at the angles of capitals of the beginning of the 13 th century. From that leaf of hepatica, Fig. 23, the artists of that epoch have made great use; sometimes they have superposed these leaves to form the bands of archivolts, c correctly retaining this concave modeling, simple and smooth, but slightly accenting the divisions of the leaf.

Note 1.p.504. A little larger than nature.

Note 2.p.504. From the external cornice of the hall of the synod at Sens; about 1235.

Note 3.p.504. Bond under the great gallery; about 1215.

Note 4.p.504. Natural size.

Note 1.p.506. From the cathedral of Paris! about 1220.

Although the lay school evidently wished to break with the traditions of Romanesque sculpture, one still feels until about 1240 some vague remains of that influence sometimes enter. Perhaps also the art objects brought then from the East to t the West furnished certain ornamental motives, that cannot be derived from the French flora; but these examples are so rare, we may say are so slight, that they only confirm the rule. B Besides, the masters who constructed our edifices of the beginning of the 13 th century were compelled to have recourse to such a great number of sculpturs to realize their conceptions, that they must frequently employ both old and young men; the former were necessarily permeated by Romanesque traditions, and could not abruptly adapt themselves to the new mode, and mixed timidly the remains of the art of their time with the models imposed on them. As proof of the aversion of that school to those old traditions, is that one finds no reminiscences of the past in sculpture, except on certain sacrificed p parts, slightly apparent on the monuments. Where the sculpture was visible, or it occupied an importaut place, on the contrary one recognizes the use of the new flora from the first years of the 13 th century.

The spirit of analysis and research, the rationalism of the lay school rejected Romanesque traditions in the architectural ornamentation as in the construction; at first because those traditions belonged to the ancient religious orders, and that the general reaction occurred against those orders; then because the new school took everything into account, or rather gave to itself reasons for all that it created. That was a s system which was inflexible, like all systems, imperious in its expression, admitted no concession, no digression. It was a radical reform.

If as we have seen at the beginning of this Article, the C Cluniac monks introduced in their sculptured ornamentation s some plants borrowed from the local flora; if perhaps they f first placed the art of the ornamentist in that path, it must indeed be recognized that they adopted a great number of ornaments derived from the Roman decadence, some others taken f

from objects or fabrics furnished by the East. As we have had occasion several times to mention the last fact, it is necessary to give proofs, while remaining within the subject of t this Article.

We posses in France today, thanks to our gardens and our h hothouses, a great number of plants that came from the depths of the East, and that in the 11 th century were entirely unknown in France. For example, such is that charming plant designated by the name of Dicentra, whose beautiful clusters of flowers assume such elegant forms and so original contours. (24). Dicentra comes from China and India. We do not know if in the 11 th century of our era it was found on the banks of the Tigris and Euphrates; but what is apparent to us is, that the very characteristic form of these flowers is reproduced on the fabrics or the most ancient objects brought from the East through Byzantium. Now we find on the mouldings of the transverse arches and archivolts of the abbey church of Vezelay ornaments, that are merely a badly understood and second hand interpretation of these flowers (25). We could multiply these examples, but it is necessary to limit ourselves. It is very well understood that these ornaments, in the eyes of persons that claim to find for everything a reason and an origin, were only barbaric conceptions due to chance with no signification, and that consequently they should be rejected. Thus the lay school soon fell into the abuse of its system; after having interpreted and arranged the natural flora of the fields to apply it to the severe requirements of monumental sculpture, it comes to scrupulously imitate that flora, at first with reserve by carefully selecting plants, that by their forms best lent themselves to sculpture, then later by taking the most flexible and slender plants, then even by exaggerating the modeling of those natural productions. This second p phase of Gothic art is more easily made known than the former; it is still full of interest. In more closely approximating to nature, the sculptors of the middle of the 13 th century, fine and scrupulous observers, seized the general characteristics and form of the plants, and reproduced those characters skilfully. They loved the plants, knew their charm, knew how are attached the petioles of the leaves, and how are arranged their fibrous ribs; they retain and reproduce with care those

outlines, so beautiful because they always express a function or are subjected to the needs of the organism; they find in the plants the qualities they seek to accent in the structure of their edifices, something true, practical and reasoned; thus there is perfect harmony between that structure and the ornamentation. This is never a facing or superfluity. The ornamentation of Gothic architecture of the fine epoch is like a natural vegetation of the structure; thus one cannot satisfy taste by adopting a mode of construction of those reasoning architects, then desiring to apply the ornamentation taken from elsewhere or from fancy. (As we have demonstrated elsewhere), Gothic construction is the result of a reasoned and logical system, mouldings are traced because of their purpose; likewise also the ornamentation has its laws like the natural products serving it as types. Those artists go so far as to admit the variety, that is found in the leaves or flowers of the same plant, and they have observed how nature proceeds, and proceed like them. Why and how have we lost those charming faculties inherent in our country? Why have we abandoned those methods of art derived from our Gaulish spirit? Instead of having recourse to true sources, to models that our intelligence supplies to us, our faculty of understanding nature, why have we sought foreign and degenerate arts, to copy without understanding them, then to recopy those copies? We refrain from saying that here, because that subject would carry us too far. (Arts. Gout; Style). Let us simply state, that what is commonly called the caprices of Gothic art, in the structure as well as the ornamentation, are very logical and very refined deductions from a body of doctrines established by a series of true, profound aud correct observations.

A proof that the principle of ornamentation adopted by the great lay school of architecture is fertile, is that each province makes a different application of it by reason of its individual character. In Ile-de-France the servile imitation of plants made itself felt only quite late, about the second half of the 13 th century; for a long time the interpretation of nature and style persisted in the great ornaments, material imitation being only permitted in some details of too little importance to influence the lines of the architecture. Material imitation appeared earlier in Champagne; it rapidly

to dryness and mannerism. In Burgundy imitation makes itself felt when Gothic appeared; but it long retains such a character of grandeur and power, is so living, that it hides its m models under its copious appearance. The architectural flora of Burgundy until the end of the 13 th century possesses a broad and energetic character, that never falls into mannerism; it is always monumental, although frequently reproducing plants with scrupulous accuracy. Not in Burgundy is it necessary to go to seek those delicate friezes and archivolts of foliage, that we see sculptured from 1257 on the south portal and beneath the voussoirs of the red portal of Notre Dame of Paris, or the ancient portal of the chapel of the Virgin of S. Germain-des-Pres;[1] but we also find there in the monuments of the middle of the 13 th century great capitals with broad foliage and high friezes with broadly treated vegetation in stone. B Burgundian sculptors seek plants with leaves strongly divided, like those of columbine (26), chrysanthemum (27) and parsley (28); whose petioles and fibrous ribs and long, properly attached and strongly accented. They love the young shoots of t the vine (29), the buds of convolvulus (30), the leaves with such beautiful character of the scabiosa (31). They disdain t the sweetbrier, often reproduced by sculptors of the 13 th c century, the trefoil, the leaves of mallow, briony, of the U Umbelliferae, celandine with such soft modeling, potentilla so refined, and geranium, so delicate. If they desire to use foliage with simple contours but strongly modeled, they gather aristolochia, violet, sorrel, hepatica, strawberry, plantain and ivy. For example, observe how those bold sculptors have utilized the leaves of the chrysanthemum and of parsley. On the principal portal od the facade of the abbey church of Vezelay is seen a beautiful archivolt built about 1240 around the arch of the 12 th century. This archivolt consists of a series of voussoirs, each bearing in the hollow a large bunch of leaves vigorously recurved and cut by the hand of a master. One of these branches A, that we give here (32), reproduces the leaves of parsley; others at B, the leaves of the chrysanthemum.

Note 1.p.510. Fragments deposited at S. Denis, about 1250.

This ranged and continuous sculpture, subject to the mouldings, we do not find at the same epoch on the monuments of I

Ile-de-France. It is a real vegetation reproduced with an excess of sap. Burgundian blood has pushed the hand of the artist. He takes nature but does not arrange it like his colleagues of the banks of the Seine and Marne, he develops and exaggerates it. Is not this an art which thus permits the artist to impress so strongly his character on his work, while folliwing an accepted principle? Although the sculptors of our t three French lay schools chose the plants that accorded with their temperaments, all scrupulously apply certain laws, that in the eyes of the botanist are not sufficient to indicate t the individuality of the plant, but which for the artist are the true ones; those that observation gives to each imitation of a plant its appearance and proper character. When today we copy a hundredth copy of a leaf of acanthus or angelica, because the Greeks imitated those plants, we can cause our ornamental sculptors to execute a work perfect in execution in marble, stone, stucco or wood, but we cannot give the apparent qualities of life to those imitations by a hundredth hand, th these are only cold decorations that interest no one, cause one to think of nothing else, only that we have caused to be made a capital or a frieze. It is even allowed that to occupy as little as possible the eye of the passer, we repeat the s smae capital ten, twenty or a hundred times, from that identical model. This point being established, that for architecture to be classical it must be wearisome, under pain of being put to the ban of the classical school, we cannot attempt to interest the public by our works. Provided that the carved ornamentation be proper, equal and uniform, everyone must be s satisfied; one does not worry himself to know if those leaves extending on our tympanums, those scrolls developed on a frieze, have some points of relation to plants; whether they are created liveable, if they submit to those laws of the natural flora, admirable because rational. The artists of the 13 th c century, that men desire to believe were left to caprice, have other scruples; they think that ornaments subject to some arrangement should not all be cut in the same mould; that the public will take some pleasure in seeing twenty capitals differing in details; that it would prefer to find around those capitals, on those bands and under those archivolts, the plants of its fields; that to imitate for sake of imitation, it

is better to seek its models in nature, which is always true, frequently beautiful and varied, that to copy Byzantine embroideries or Roman ornaments executed as taskwork by artists c careless of form , according to badly understood traditions; that the local flora being accepted as the starting point of all ornamentation, the types being sufficiently varied, easily found and living, everyone can find innumerable applications of those types, according to his taste and his merit; that in the arts, if it be necessary to establish very rigorous principles, it is necessary to permit all the applications that can be made. So well that those lay artists of the 13 th century, who firmly believed that they opende to the arts an era of liberty and progress, and who in fact did open it, would probably be astonished if they heard today, by those who desire to rivet us to the arts of antiquity and their unreasoned applications, that this art of the 13 th century is superannuated and without new applications.

"Well, who prevents you from using it? They might reply; we have not improved forms, have only brought forward principles, either in construction or ornamentation; it is true that we h have taken the form that seems to us to best accord with those principles and our taste; but who forbids you to take others or to modify these that we have adopted? Do you believe that you are original because you imitate a capital of Mars the Avenger, or a house of Pompeii, an arabesque of the Renaissance, a cartouche of the 17 th century, or a frieze of the boudoir of Madame de Pompadour? Do you not think that there will be more chances of inventing new forms by collecting in the forests some of those plants on which you walk indifferently; by analyzing those plants as we do ourselves; by examining t the angles of their petioles, the causes of their leaves, the attachments of their shoots? Who requires you to copy our capitals? Seek the same models as we do, try to understand them better than we do, which will not be difficult, since you are wiser and the entire earth brings its plants to our conservatories. Must we copy each other reciprocally? Did not our artists have recourse constantly to those natural sources? There are perhaps a million capitals of our time in France, but you will not find two identically similar; it is the same for all our sculptured ornamentation. We have represented thous-

thousands of times the leaves of the vine, fig, ivy, geranium, maple, pomegranate, violet and fern; but to make a maple leaf, we do not copy the sculpture of our neighbors, but go to walk in the thickets; hence the maple leaves carved on the edifices that we have erected are as varied as are those that grow in the forests. Further, with those fragments of plants we compose and invent new combinations; why not do as we have done, and how will this method cause you to retrograde? -- To retrograde is your greatest fear. -- Very well; for that do you re reject the sole art, that allows one to advance because of t the breadth and liberality of its principles? And to mention only the scluptured ornamentation, do you think to open new paths by copying a flower chiseled by Etruscans, by poorly r reproducing some beautiful capital of the time of Augustus, or by imitating the debased sculpture of the end of the last (18 th) century? Still you state that it is more conformable to unchanging taste to copy the Romans or the heavy caprices of the age of Louis XIV, while the fields continue to be covered each spring by their charming verdure, the trees always shoot forth, the flowers do not cease to bloom; why then do you not draw from that inexhaustible treasury? This is why we desire to foud an art method always young and living, that we draw from it ourselves. Are plants less varied, have they less grace and flexibility than in our time?"

What could one reply to those artists, who speak in their works, our predecessors by six centuries, but more youthful t than we are, and especially more friends of progress?

What one cannot study too much in the application as made by those artists of the flora to sculptured oruamentation, is the exact observation of the principal characteristics of the form. They neglect or suppress the details; but what they express with the care of passionate lovers of nature are the gr grand lines, those that characterize each plant, as for example, the angles formed by the fibrous ribs of leaves, the appearance of the petioles, the beautiful lines given by the edges of those leaves, the character of their serrations, the projecting profiles of the modeling, the energetic swelling at the junctions. Let us analyze this, for on this subject th that appears to us important, should be left no uncertainty in the minds of our readers. For example, the leaves are only

flexible in one sense, they can be bent in the direction of t their thickness; but because of the fibrous tissue that forms a stay between their edges, they cannot be bent edgewise. Thus (33) a maple leaf A can be bent as indicated by the sketch B, but one cannot give it as in sketch G without destroying or crumpling its tissue and altering its form. Yet we see that since the Renaissance, when the study of these natural productions was replaced by imitations of intique sculpture more a and more corrupted, our sculptors of ornament have infringed that principal law. On the contrary, its observation leaves to monumental sculpture a firmness and necessary life. If G Greek artists have to make a frieze or a garland of leaves; by placing the leaves in all directions according to the requirements of ornamentation, they take care to preserve for e each leaf the immobility, that it must necessarily retain in the direction edgewise. To obtain variety in the modeling, t they sometimes present the back of these leaves, sometimes the front, as shown in Fig. 34.[1] They note that the fibrous ribs necessarily impose thi form of the tissue, just as the bones of animals determine the form of the muscles. Then they direct all their attention to the fibrous ribs, so that being obliged to suppress certain details to give the sculpture the monumental appearance which it must retain, they can always retain the appearance of the plant. Thus for example, from the fig leaf they omit many of the serrations, quite soft in form and that weight the leaf, but (36) [2] they retain accurately the angles of the fibrous ribs; they exaggerate the character of the principal indents; they seize all the dominant points, the beautiful lines of those indents; they give to the quite flat modeling of that leaf great energy, while still respecting its curves.

Note 1.p.517. From the rood screen of the cathedral of Chartres; fragments , about 1245.

Note 2.p.517. From Notre Dame of Paris; south portal, 1257.

But if we cast our eyes on Fig. 35, we see that in the leaf of the Fig., as in most leaves, the outlines are contrasted, yet retaining at each side of the fibrous branches portions of tissues, that present a certain symmetry. Thus opposite t the depressions A are found the expansions B. The same observation can be made concerning the muscular contours of animals.

The sculptures of the middle ages have therein followed the natural rules in all cases in which the needs of ornamentation did not compel a rigorous balanciug of the two edges, as in t the middle parts. Fig. 36, that shows us how the sculptors have interpreted the leaf of the fig, only gives two borders absolutely balanced on the cenaral member of the leaf; as for the six other members, they are curved according to the natural principle. Their imitation of the flora is thus perfectly intelligent; the artist knows how to make the sacrifices necessary; from the plant he produces a work of art that belongs to him, although he retains and even emphasizes the distinctive characters, qualities and charms of the natural object. The sculptured leaf that we give here has an appearance much more characterized than the leaf of the tree. It is more the leaf of the fig tree than the real one (from the point of view of art, if not of science).

It is rare that the sculpturs of the 13 th century take as leaves as large in scale as this; usually, as we have already seen, they seek their inspirations in smaller plants, because these possess simpler forms, more energetic outlines and more powerful modeling. One can see by the examples already given, what use the ornamentist can make of plants, that scarcely r rise above the ground. What seems to have determined choice by those artists is, first the beautiful arrangement of the petioles and fibrous ribs; then the angles and contours given by the tissues of the leaves. When the contours are soft and do not clearly accent the anatomy, oppose the direction of t the fibrous ribs, which occurs sometimes, they reject the leaf. Thus the leaves whose anatomy is most beautiful and clearest are those of the smallest plants.

Here (37) is a very common fern, drawn a little larger than nature. Is there anything more energetic in arrangement of lines and recief than this little plant? Let one observe the b beautiful curves of the petioles, the delicacy aud firmness of the junctions, and he will comprehend that a sculptor can make great use of this model; hence he did not fail to be inspired by it in the ornaments of the 13 th and even the 14 th centuries. These delicate serrations of the ends of the leaves have frequently served as the means of decorating great ornaments, and which was given a delicate and precious appearance.(38)[1].

Note 1.p.520. Capital from nave of Notre Dame of Paris; triforium, about 1205.

The artists of the 15 th century only sought examples among plants with strong relief; they chose black hellebore, chrysanthemums, sage, pomegranate, strawberry, mallow, geraniums, ferns with broad leaves, oak, maple, passion flower, ivy,and vine, and they copied the leaves of these plants with rare p perfection, frequently exaggerating their modeling or contours. They abandoned those buds and seeds with which the artists of the end of the 12 th century had known how to compose s such beautiful ornaments. Not only did they choose leaves at their full development, but they loved to crumple them; what they desired was to produce effect, and on the whole, their ornaments became confused and mean by the lack of simplicity in contours and relief. From the leaf of the vine, where the relief is broad and arranged in great planes, they found means to compose ornament (39).[1] They loved undulating lines, leaves folded and rumpled; they gather that great fern that grows on the surfaces of damp walls (40); they observe those capsules or sporangias A placed on the lower surface of the leaves, a and that form bosses on their external surface, and also exaggerating the folds of the leafy appendages, they obtain ornaments with crumpled outlines, coarse relief, whose appearance is attractive near,but at a distance only presents more than one series of recessions of lights and shadows very difficult to comprehend.(41). [2]

Note 1.p.521. From the tomb of bishop Pierre de Roquefort. S. Nazaire of Carcassonne; about 1325.

Note 2.p.521. From the abbey church of Eu.

About the beginning of the 15 th century, the imitation of plants fell absolutely into realism. Sculpturs then chose the most dissected leaves, passion flower, thistle, thorn, wormwood (42); and from the last plant, so small that it is scarcely perceived on the stony ground on which it grows, they composed great and wide friezes, bands, energetic crockets, but with altered leaves in excess. Yet one conceives that with these leaves, whose lines are beautiful, can be made grand o ornaments; this was also the remnant of the traditions of the lay school of the 13 th century, which sought its models for ornaments among the smallest creations of the plant order. The

The artists of the 15 th century also loved to imitate the f fresh or salt algae with very strong relief. (Arts. Fleuron; Sculpture).

At the end of the 15 th century Gothic artists had attained the last limit of the possible in the art of construction; as for ornamentation, they had even gone as far as they could in the imitation of the most delicate plants, the most difficult to render in stone or wood; the Renaissance came to arrest that progress of sculpture toward excessive realism. During several years from 1480 to 1510, one sees the French school of sculpture mingle its traditions with reminiscencer of antiquity; but it is easy to recognize that artists no longer draw from natural sources, that they no longer consult the flora, and that their ornaments are nothing more than patterns more or less skilfully executed. They copy or rather interpret ornaments borrowed from antiquity without understanding them; by combining these imitations with the last vestiges of Gothic art, they still produce remarkable works, the taste for sculpure was then alive among us, while the executors were skilful with their hands. But through this confusion of styles and o origins, one indeed has difficulty in following the course of an art; it is a movement impressed by a powerful school, that continues long after the disappearance of that school. However, gradually the execution is enervated, and the art of sculpture and ornament at the end of the 16 th century is no more than a pale reflection of what it still was in France under the reign of Louis XII; the study of nature enters nowise into the composition nor the work of the artist; the ornaments lose that living and original character, that they possessed a century earlier to reproduce gradually types, that daily de-degenerate. About the beginning of the 17 th centurw, the ornamentation improves somewhat by reason of a more careful study of antiquity; but originality and sap is lacking thenceforth in that art, which our old lay school had known how to elevate so high.

FONDATION. Foundation. Footings.

The Romans of the empire always founded their edifices on a resistant soil by means of great layers of concrete, that formed homogeneous and solid footings under the structures, com-

composed of fragments of stone, pebbles, sometimes of pieces of terra cotta, with excellent mortar. Roman foundations are real artificial rocks on which could be placed the heaviest structures, without fearing ruptures and settlements. Besides, Roman construction being of concrete without elasticity, it was necessary to establish it on immovable bases. During the Romanesque period, edifices are generally badly founded, due to several causes; men knew little of the nature of soils, so considerable accumulations of materials were difficult, and they no longer knew how to burn and properly employ lime. We have explained elsewhere (Arts. Carriere, Construction) the reasons opposed to the Romanesque constructors for collecting much material in a brief time, and why without the resources at the command of the Romans, they often neglected the foundations of the most important buildings.

The lay architects of the school of the 12 th century had seen so many Romanesque structures fall, by defects in foundations or because of the thrust of vaults badly abutted, that they desired to avoid these disasters; for that purpose they took particular care to establish durable foundations, and to render their structures sufficiently elastic that settlements were no longer to be feared. But however skilful we assume an architect, it is necessary to supply him with the material m means of construction; now in the erection of the great cathedrals and many churches, the enthusiasm and zeal of the bishops do not always correspond to the extent of their financial resources; then the secular clergy especially desired to make its influence appear; it acted for itself to lessen the influence of the monasteries, to draw the faithful to itself; in many cases then with means relatively insufficient, men desired to erect religious edifices, that could surpass in extent and richness the churches of the Benedictine monks. This explains why some of our great cathedrals, like those of Troyes, Chalons-sur-Marne, Seez, Meaux, are badly founded. It was necessary to erect rapidly sumptuous edifices of beautiful appearance, and the resources being relatively moderate, men were unwilling to bury them in the ground in great part. Other cathedrals erected in the midst of rich dioceses, like those of Paris, Rheims, Amiens and Bourges, on the contrany are founded with extraordinary luxury of materials. As for the castles,

military and civil structures, they are always well founded; the lay lords and the municipalities regarded appearance less but desired durable structures, because the lord of the castle built to protect himself and his family in perpetuity, and the cities built for a long series of generations.

The foundations of the Romanesque period are always made of great masses cast pell mell into the bed of mortar; they are rarely faced. The foundations of Gothic structures, on the c contrary, are faced with surfaces of cut stone ashlars set in regular courses and properly shaped; the masses are laid with rubble set in good mortar. (When the resources are not wanting), these foundations have wide footings and rest on resistant s soils. Yet it must be stated on this subject, that the Gothic constructors had not the same scruples as we have; when they found the soil formerly filled, well compressed and settled by water, they did not hesitate to found on it. Old silt and mud deposited by water, fillings long percolated, appeared to them to be sufficient soils; but also in that case they gave a broad bearing to the base of the foundations. They never failed to connect together all the walls and masses in the foundations; i.e., for example, beneath an edifice composed of wa walls and of isolated piers, they formed a grillage of masonry underground, so as to make all parts of the foundations st stable. During the 14 th and 15 th centuries foundations are always established with extreme care on virgin soil under the principal points of support, and numerous connecting walls. It even frequently occurs then that the surfaces of foundations are as well dressed as those in elevation. (Art. Construction).

FONTAINE. Fountain.

At all epochs, fountains have been regarded as monuments of public utility of the first order. When the Romans established a city, or when they took possession of ancient cities, they thought of the management of the water supply before all else. They went afar, if necessary, to seek abundant and pure sources, and they recoiled from no labor or expense to bring considerable volumes of water into the centres of population. At Rome, although four fifths of the ancient aqueducts are destroyed, those remaining suffice however to supply the modern ci city with a greater quantity of water, than that furnished to

the city of Paris with five times the population. At Nimes, L Lyons, Frejus, Arles, Autun, even at Paris, we still find traces of Roman aqueducts bringing water from very far and at high levels, in order to secure easy distribution by means of great reservoirs. Everywhere in France that is found an abundant and sanitary source, one is almost certain to discover the ruins of Roman constructions. The Romans attached major importance to urban sanitation; there is no sanitation without a good c city government, and there can be no good government without water. In that respect we have something to do; many of our great cities still lack water today; then one should not be surprised, if during the middle ages fountains were not very common in the midst of cities. Among the Romans, water was a true ornament of all fountains; men had not yet thought of e erecting fountains in which water would be an accessory more inconvenient than useful. The few fountains of the middle ages that we have been able to collect have not that monumental appearance, and do not present that mass of stone, marble and bronze, that one believes himself obliged to accumulate in o our days to accompany the thread of water. Still (and that is probably derived from the traditions of antiquity) water seems a thing so precious, that it is only given to the public when surrounded by what can emphasize its value; it is economized and placed within reach of all, but with more respect than v vanity. The fountain of the middle ages is then a monument of utility and not of decoration, a pretext for representing allegories in marble and metal, more or less ingenious, but which all have the great defect of being ridiculous for men with a moderate belief in mythology, bearded rivers and naiads crowned with roses. The fountain that imprints a vivid trace in the memory, is that found at the side of a dusty road, allowing its basin of limpid water to be seen beneath a shelter, i its copper cup attached to a chain, and a modest inscription recalling the name of the founder. Without always being as h humble, the fountain of the middle ages retains something of the simplicity of this programme; it does not deafen or splash, but it invites the passer to approach it. It is not necessary to receive a shower to quench thirst.

The fountain of the middle ages is a little covered basin f from which one can draw by descending some steps, or a column

or pier surrounded by the large basin and with a more or less great number of pipes distributing the water to all comers. The basins surrounded by steps were reserved in gardens and orchards. In the stories and tales of the 12 th and 13 th centuries, is frequently mentioned this sort of fountains,[1] and without leaving the domain of reality, we still see in Poitou, Normandy, Brittany, and Burgundy, quite a large number of fountains placed at the edges of the roads for the needs of the traveler. The spring is ordinarily covered by a masonry arch, the basin extending toward the road as if to invite one to d drink there; benches allow one to rest at the side; a niche i is arranged at the rear of the vault that receives the statue of the Virgin or of a saint; the arms of the founder decorate the tympanum of the arch or the wall of the fountain (1). Outside the suburb of Poitiers, beside the Clain, is to still be seen a fountain of that kind, restored in 1579, but whose construction dates in the 14 th centurw. It turns its back to t the street, and one reaches its basin by means of a flight of steps at one side of the little structure. The arms of the gi- giver are placed so as to be recognized from the road aod from that flight. The arrangement of those fountains is evidently very ancient; one recognizes in them a trace of Roman antiquity. A little building protects the spring and receives the d deity that is its dispenser, an inscription giving the name of the founder for public recognition, benches for resting, is not that an antique programme? But this sort of fountains is only suited to the countrw; in the cities, on places or crossings, it is necessary for the basin to be accessible to a great number of persons at a time. It is essential for one to obtain water, not in the basin stirred by the movement of persons carrying off water, but at the source itself distributed in a certain number of channels.

Note 1.p.527. See Loi de Norcisse, Loi de l'Oiselet, Porodis d'Amour; in the lost tole the outhor describes o fountoin conceoled in o gorden. He soys thot one descended to it by morble steps, to which wos ottoched o cup of enoweled gold by o silver choin.

Thus was arranged the fountain of the 12 th century that one still sees at Provins opposite the hospital (2). A hexagonal basin, a great column whose capital is pierced by three holes,

fitted with bronze heads projecting sufficiently to pour the water into vessels set on the border of the basin, such is this little monument in its primitive simplicity. Perhaps formerly this capital was surmounted by a statue or a pinnacle, like certain fountains seen represented in paintings and manuscripts of the 14 th century. At A is traced the plan of the fountain of Provins, at B is given the detail of one of the bronze pipes.

Some cities of Italy, Perugia, Viterbo, Siena, have retained their fountains of the end of the 13 th century and beginning of the 14 th. In France we possessed at that epoch very beautiful urban fountains; but we destroyed them long since; it is rarely by chance that one discovers some fragments of those monuments due to the generosity of sovereigns or of r rich lords. They were composed in nearly the same manner, i.e., they consisted of a lower basin raised by two or three steps above the ground (2.0 to 3.9 ft.), a very deep basin made to collect the water from the spouts, to place and wash the vessels, the basin in which one cannot drink; the central pillar receiving long distributing pipes extending nearly to the border of the lower basin, allowing pitchers to be filled. The central pilla was more or less decorated, sometimes bearing an upper basin allowing little jets to escape only for pleasure. There was on place of Notre Dame at Paris a very beautiful fountain of this kind, that was replaced in the 17 th century by a very heavy monument; one sees one yet, though mutilated and changed, on the place of the city of S. Florentin. At Brioude exist very pretty fountains of the 13 th century, most of whose details have been modified. The cities on the banks of the Rhine and in Germany also possess some monumental fountains of a quite recent epoch (15 th and 16 th centuries), although drawn according to the old programmes.

We give (3) one of those fountains of the 13 th century in plan, and (4) in perspective. The plan (Fig. 3) indicates at A the horizontal section of the monument the lower basin; at B the section above that basin, and at C the section of the u upper pier supporting the statue, with the projection of the two superposed basins. Those fountains were supplied by means of subterranean aqueducts, as we have frequently had occasion to state. Those aqueducts were usually of masonry, lined inside

by good cement according to the Roman method; pipes were rarely of lead; yet we have found fragments of them at Carcassonne, Clermont (Auvergne), and in the vicinity of ancient abbeys, at S. Denis near Paris and Clairvaux. Near Coutances are still s seen the remains of an aqueduct that appears to date from the 14 th century, and that is borne on a pointed arcade extending across the valley northwest of that city. Du Breuil, in his Theatre des Antiquiter de Paris, states that the provosts of the merchants and sheriffs had "from antiquity to bring water from the sources to the fountains of the city, to cause the construction of great aqueducts and canals, build walls of ma masonry of cut stone, pave with stone also the great gutters and basins (as they also covered these with very large stones), those aqueducts being 3200 ft. or more in length, without there being any light except by carrying fire, and 6 ft. in height by 3 ft. in width, along which persons could easily walk with a light in hand; which aqueducts are accompanied by basins or receptacles to agatate and purify the water of the said springs; at the entrance of which is a form of structure, where there is a great receptacle serving as an emissary to receive the water descending from the sandy mountain, called mountain of Belle-Ville-sur-Sablon, on the top of the said aqueduct being an opening of round form, at the middle of which is a sort of well to receive the fine springs descending into it at three different places. The edifice is vaulted in domed f form, with its opening for an open lantern; in that are two stairs of similar round corm; edifice artistic and curiously built; which gutters and basins were rebuilt anew in the year 1457, about 505 ft. in length, the rest of the said aqueducts or channels being very ancient." Whether this aqueduct was of Roman origin or was built in the first centuries of the middle ages, it was always used, and was still maintained in the 15 th century.

It is principally in the monasteries that are found the most numerous and best preserved traces of hydraulic works. All cl- cloisters possessed at the centre of the court or beside one of the porticos beautiful basins of stone or marble, around which pipes distributed the water in a number of jets, permitting the monks to make their ablutions. (Art. Lavabo). These fountains nearly all assume the same form until the end of the

14 th century. In the 15 th century, the column or group of columns placed at the centre of the circular , polygonal or lobed basin, is often replaced by a pinnacle decorated by sculptures.

Such is a fountain (5) that we see represented in a manuscript of that epoch. [1] At Rouen still exists a very pretty monument of this kind that dates from the middle of the 15 th century.[2] When Gothic fountains were placed against a civil structure, they only consist of a little basin and channel placed in a recess made in the wall itself; however modest were our hydrants, they were only made to satisfy the daily needs of the inhabitants. The middle ages saw no inconvenience in putting a little art into its most ordinary works; today if we carry to exaggeration the richness and luxury of the ornamental monuments of our cities, we compensate for that fault, if it be one, by the poverty and vulgarity of the most useful objects, such as our hydrants, candelabras, and lamp posts.

Note 1.p.533. Poems of William de Machaut. Mss. of M. Guillebon.

Note 2.p.533. Fountain called de la Pucelle.

FONTS BAPTISMAUX. Baptismal Fonts.

A basin intended to contain the water for beptisms. There is no reason to suppose that in the first times of the Church, baptism was given by sprinkling, since the apostles baptized kingdoms and entire provinces, thousands of persons in a day.[3] Baptism was then made in a basin, then by immersion. The Arians plunged the candidate three times in the water to mark that there were three natures as well as three persons in God. S. Gregory the Great counselled S. Leander, bishop of Seville,[5] to practise only immersion. The fourth council of Toledo in 1633 decided likewise, and recalling the letter of S. Gregory, it declared that a single immersion signifies the death and resurrection of Jesus Christ, and the unity of the divine nature in the trinity of persons.[6] Without entering into more ample details on this subject, we shall content ourselves by stating that during the course of the middle ages in the West, baptism by immersion was always practised. The reliefs, paintings of manuscripts and stained glass show us candidates baptized by immersion. "Formerly," says Thiers,[7] "in the province of Rheims, and also perhaps elsewhere, after the baptism

wine was given to the infant to drink, saying these words to it. May the body and blood of our Lord Jesus Christ guard thee in life eternal. It was still the custom in Perigord to bless the wine after baptism and to cause the newly baptized infant to drink of it. The ritual of Perigueux of 1536 gives us that entire ceremony." This author adds later:- "Since a little more that a century (i.e., since the beginning of the 17 th century) the custom was introduced in many parishes, and particularly in the country, to ring the bells after the baptism of infants. In my opinion, the bell-ringers, sacristans, sextons and beadles, introduced it in consideration of their financial gain. The provincial council of Rheims in 1583 did not authorize that custom.

Note 3.p.533. S. Luke. Acts, Chapter 2 and 4.

Note 4,p. 533. Arcudius. De Sacram. LI.

Note 5.p.533. The same. LIII. Letter 41.

Note 6.p.533. The same. Chapter VI.

Note 7.p.533. Des Superstitions. Vol. II. chap. 12.

Until the 9 th century, it appears that they baptized solemnly only on the days of Easter and Pentecost; at least that c custom seems to have been established after the 5 th century, for it is certain that in the first centuries of Christianity the apostles baptized without observing either days or times.[1] Clovis was baptized on Christmas day.[2] Pope S. Leon, who arose strongly against the custom of baptizing at any other time than the day of the resurrection, however admits that baptism can be given in extreme cases on other than the consecrated day.

Note 1.p.534. Latin Note. See William Durand, translation e edited by M. Barthelemy. Notes. Vol. IV. p. 430 et seq.

Note 2.p.534. Letter of S. Avitus, bishop of Vienne to Clovis.

The solemnity given to the sacrament of baptism explains, w why there was a baptistery in the vicinity of the oldest churches; i.e., an edifice sufficiently large to contain a certain number of candidates coming the same day to receive baptism. These edifices were usually circular, the centre being occupied by a shallow basin into which were caused to descend the persons baptized by immersion.[3]

Note 3.p.534. There exists a baptistery beside the basilica of S. John Lateran at Rome; one has recently been discovered near the old cathedral of Marseilles, from the 5 th century.

still exists a font of stone, cut so as to represent a basin inscribed in a frame supported by little columns. That tradition still persists during the 13 th century as proved by Fig. 3, copied from the font of the church of Ver (Picardy).[1]

Note 1.p.536. We owe these drawings to the coutesy of M. Duthoit of Amiens.

Frequently the baptismal fonts of the 12 th century are of rectangular form, probably to entirely immerse the infant that is baptized. There exists the baptismal font of that form and of that time in the cathedral of Amiens; it is a large triangle about 2.0 ft. wide by about 5.2 ft. long with a depth of 1.64 ft. It is very simple; at the four angles only are sculptured the figures of the four evangelists, in high relief and of small dimensions. The feet that support it date from the 13 th century.

We give (4) a small font of this kind, that comes from the church of Thouveil. It dates from the 11 th century. The church of Limay near Mantes possesses baptismal fonts of the beginning of the 13 th century, whose form also approaches that, but which are quite richly sculptured. This font, reproduced in the work of M. Gailhabaud,[1] is of oval form inside, an elongated dodecagon externally; two of the sides parallel to t the main axis present slight projections reserved to better detach the angles of the prism, which at that point would h have been too soft. A beautiful band of leaves ornaments the upper edge; the intermediate portion is occupied by 12 rosettes among which are sculptured a paschal lamb, a cross and an ox's head. The base is recessed and presents a series of small arches. The paving around those fonts presents a very remarkable peculiarity; there are 8 disks of gray stone placed on the surface of the slabs, and that seem to mark the places of persons, that should surround the font at the moment of the baptism. A hinge was placed at the edge of the font to receive a cover; these are indeed baptismal fonts according to the decrees of the councils, that must be covered from a very ancient epoch, as they still are today.

Note 1.p.537. L'Architecture et les arts qui en dependent.IV.

The baptismal fonts of the parish church of the city of Cluny merit mention; cut in a block of stone, they assume the form of a hemispherical bowl inside, and are decorated externally

by four little columns supporting four heads, between which extends a frieze of ivy leaves in good sculpture (5). The four small shelves borne by the heads had a use, and probably served for placing the salt, oil, and candles. At A we give the plan of that font; at B is its section. It dates from the middle of the 13 th century.

The baptismal fonts of the middle ages vary as much in form as in materials. The manner in which they are decorated permit the supposition, that great liberty was left to the artists. These fonts are polygonal, circular or even square, lobed, oval, hollowed to the bottom of the font or like a bowl; their surfaces are ornamented by foliage, simple mouldings, or by geometrical compartments; they are cut in stone or marble, cast in bronze or lead. Their covers are composed of wooden frames, sheets of metal, or are richly ornamented in form of cones or canopies, and can then only be removed by means of angles or little permanent cranes. There is no need to say that baptismal fonts in bronze, preceding the end of the last (13 th) century, were cast in France; some of them are still seen in Italy, Germany and Belgium.[1] The fonts of the cathedral of Hildesheim are particularly remarkable. "The font," says M. de Caumont,[2] from whom we borrow this description, "rests on four personages, each having one knee on the ground, and holding an urn, from which water flows over the pavement; these figures are emblematic of the four rivers of paradise; and on the circle borne by their shoulders is read the following injunction, explaining the symbolic relation of each of these rivers of prudence, temperance, courage and justice. (Latin inscription).

Note 1.p.540. L'Arch. e.l.orts q. en dep. Vol.IV. gollhoboud.

Note 2.p.540. Bull. monum. Vol. XX. p.299.

The font is decorated by fair reliefs representing the passage of Jordan by the Israelites under the lead of Joshua, the passage of the Red sea, the baptism of Jesus Christ, the Virgin and Child Jesus, before whom is the giver, bishop Wilhelms. Above the four rivers are 8 medallions representing Prudence and Isaiah, Temperance and Jeremiah, Courage and Daniel, Justice and Eqekiel. Above are seen the signs of the evangelists. The conical cover is likewise covered by reliefs. These fonts of the second half of the 13 th century are perhaps the most beautiful that exist, and those best composed by the choice

of subjects accompanied by inscriptions. We shall also cite t the bronze fonts of church S. Sebald at Nuremberg, which date from the end of the 15 th century. Around the base are placed the four evangelists in the round, and around the bowl are t the 12 apostles in relief within an arcade of delicate work.

By the lack of those monuments, precious by work and material, we longer find in France only fonts of small value. The church of Berneuil contains fonts, that present a certain interest. The bowl is of lead and dates from the 12 th century (6); around it are arranged 16 niches alternately filled by figures in half relief and ornaments. This font rests on a s stone base with 8 sides, of a later epoch. The old cover (probably of lead and in conical form) has been replaced by a wooden cover of the 16 th century.

There is seen in the church of Lambez a little baptismal font of lead in cylindrical form, divided in two zones; the upper zone represents a hunt and the lower one has 16 figures in quatrefoils (7). The same model served five times for the upper zone, and in the lower zone the 16 figures that represent the religious orders are obtained by only four models. Th Thus this sort of fonts do not require a great cost of fabrication; casters or makers of pewter pots that sold them, composed them with models kept in stock; thus in the example here given, the subject of the chase is evidently from the epoch p preceding the little figures of the quatrefoils of the lower zone, which date from the second half of the 13 th century. A hole A made at the middle of the flat bottom of the font serves to empty it.

At Visme is a font of the same dimensions in lead but with 8 sides, that presents on its exterior 16 arches formerly filled by little figures in the round supported on corbels.[1] These fonts rest on a stone table borne by four little columns of the beginning of the 13 th century; the font is of the 15 th.

Note 1.p.542. These little figures have been removed.

As for the baptismal fonts of the middle ages, whose covers were moved by cranes or angles of iron, very beautiful examples are seen at Hal, S. Pierre of Louvain (Belgium), and S. C Columba of Cologne. Those monuments being very well engraved in the work of M. Gailhabaud,[2] it seems to us useless to enlarge on their composition. Besides their style is foreign to

to French art.

Note 2.p.542. L'Arch.e.l.orts qui en depend. Vol.IV.

Sometimes on the internal surfaces of baptismal fonts are carved fishes, shells and frogs. These are seen in church S. Sauveur of Dinan (Brittany) baptismal fonts of the 12 th century composed of a sort of bowl supported by four much mutilated figures of coarse work. The interior of the bowl, cut l like a cup, is ornamented by flutes and two fishes carved in the mass.

We shall terminate this Article by giving the stone baptismal fonts with singular ornamentation, that are placed near t the portal of the cathedral of Langres; they date from the e end of the 13 th century.

Also during the middle ages were used precious fonts, brought from the East, for baptizing infants. Everyone can see in Museum des Souverains at Paris the beautiful font of Persian work in which it is claimed that the children of S. Louis were baptized. (Old French poem).[1]

Note 1.p.544. William of Orange. Ballad of 11 th and 12 th centuries. Verse 7584 et seq. Baptism of Renourd.

When baptisteries were renounced, the baptismal fonts were placed in a closed chapel, as much as could be done. Today, fonts must not only be covered, but in a place separated from the multitude of believers by an enclosure.

FORMERET. Side Arch.

An arch agains the wall receiving the cross vault. (Arts Arc. Formeret; Construction).

FOSSE. Ditch. Trench. Moat.

A long trench made in the ground to oppose an obstacle around a camp, castle, city, park, or enclosure. These dry ditches and ditches filled with water (moats), ditches with sloping or flat bottoms, ditches faced or not faced with masonry.

Dry ditches are those cut around castles, a manor, or a place located to high to conduct and retain water.

Wet ditches are those through which passes a stream of water, or that are filled by an inlet from sea, lake or pond.

Sloping ditches are those simply excavated in loose soil, w whose sides are at 45° degrees and are covered by turf.

Faced ditches are those with sides faced by masonry walls with a slight batter.

Ditches with flat bottoms have their sides faced, and thus windows can be opened in one side serving as substructure of a fortification. Ditches cut in the rock may also have flat bottoms.

The Romans excavated ditches around their temporary or permanent camps. Those ditches were usually 15 ft. wide at top. They were often double, being separated by a road 13.1 to 16.4 ft. wide. When Cesar established his camp opposite the Bellovacs on Mt. S. Pierre in the forest of Compeigne, "he caused the erection of a rampart 12 ft. high with parapet; he ordered the excavation before it of two ditches 15 ft. wide with flat bottoms; he caused to be built a great number of towers with three stories, connected by bridges and defensive galleries, whose fronts were covered by wicker mantlets, so that the enemy was stopped by a double ditch and two rows of defenders; the first row on the upper galleries, where being higher and better sheltered, the soldiers shot arrows farther and with more certainty; the second row behind the parapet and nearer the enemy, where it was protected from arrows by the upper gallery.[1]

Note 1.p.343. De Bello Gollico. Book VIII. Chap. 9.

Country works that the Romans executed in Gaul had such influence on the art of fortification among us until a very late epoch in the middle ages, and in the time when casting machines had such small reach, ditches were such an important part of the art of defending places, that we must devote our attention to this curious passage. It is not necessary to know the locations here described by Cesar.

With the Commentaries at hand, the site of his camp was evidently chosen on a plateau situated opposite Mt. S. Mark, that in old maps is designated by the name of S. Pierre-on-Chastres.[2] This plateau has steep slopes on all sides, presenting on its top a broad horizontal area on which the little army that Cesar had with him could hold very easily, lending itself marvellously to the sort of defense, that he had adopted; a defense whose traces are further recognized at the locality itself.

Note 2.p.343. See Article of M. de Souley on the 8 th Book

of Cesar. Revue archaeologique. 1860.

Here they (1) is the section of the enclosing works. The assaillants could only reach the edge of the first ditch A by a ascending the long and very steep slope, and were seen with difficulty by the defenders placed at B; for the stronger reason they found themselves entirely masked from the defenders posted along the parapet C within the second ditch G. Those defenders placed at C were nearer, however the assailants than those posted at E on the galleries connecting the three-story towers, the line O C being shorter than the line E O. Assailants presenting themselves at K within arrow shot could only strike the defenders posted behind the parapet C by sending t their missiles in a parabolic line K L. Then the wicker work of the upper gallery E protected the soldiers posted at C. C Cesar describes very well the advantages of his works by saying that the soldiers placed at E saw the enemy farther off and could shoot at them with greater certainty. The assailants while climbing the slope P could only see the tops of the wooden towers and the galleries connecting them; they had no knowledge of the two ditches that would stop them at O. While ascending that slope, they were exposed to the arms with long reach from the upper defense; but as soon as they had reached the crest O, they not only found two obstacles before them to be passed over, but they were exposed to arrows from the gallery E and the rampart C, the latter arrows being shot directly, as indicated by the line C O, but also in a curved line as shown by the parabola H M. Admitting that the troops climbing the slope P had started, full of enthusiasm and arriving panting at O, it would have been very difficult for them to reach the parapet C. Meanwhile Cesar in the camp of Mt. S. Pierre did not fear a serious attack of the Belloracs; on t the contrary, he sought to draw them out of their own defenses. When he really feared an attack, his precautions were still greater. Around Alesia he established double lines of fortifications so as to blockade the army of Vercingetorix s shut up in that city, and to place himself on the defense against the considerable succors that threatened his camp. The enclosing line consisted of :- 1, toward the enemy a ditch 20 ft. wide anf of the same depth with flat bottom. At 400 ft. behind this ditch he established his intrenchments. In the

interval he caused two ditches to be dug, each 15 ft. wide and deep; the inner ditch was filled with water taken from the r river; behind those ditches he built a rampart 12 ft. high, f furnished with a parapet with slots. At the junction of the parapet and rampart, he planted strong palisades to prevent scaling. Towers were 24 ft. apart and flanked the entire entrenchment. These precautions did not seem sufficient to him after some sorties of the Gauls; he caused trunks of trees, b barked and sharpened, to be planted in the bottom of the ditch 5 ft. deep; five rows of these stakes were fastened together at bottom, so that they could not be pulled up. Before that obstacle, he caused conical holes 3 ft. deep to be dug in quincunx plan, at the bottom of which were set stakes hardened in the fire and pointed, that extended only 4 inches from the ground; these stakes were firmly fixed by tramping the earth around them; brambles concealed them from the eyes. These holes were arranged in 8 rows 3 ft. apart.(2). In front were fixed very close together stakes (3) one foot long and armed with iron spikes. In the memoir on the blockade of Alesia,[1] Prevost, captain of engineers, seems to us to have perfectly understood how these stakes were made, mentioned by Cesar. A Among the antique objects found near Alesia, says the learned officer, are noted iron spikes, that have solved for him the question of those stakes. These pieces of iron are 1 ft. long and 0.4 in. square at the middle; they are bent outward and pointed at each end. "All authors," adds M. Prevost, "who have spoken of Cesar's spikes, believed that they consisted of a r round wooden stake sunk in the ground with an iron point fixed therein and projecting above the soil. However simple might be that object, it is still difficult to execute; many stakes would have been split in trying to force in an iron spike; it would then have been necessary to point this by filing it cold, which would have required much time;" (then it would h have been necessary to have files); one would have needed to strike carefully on the head of the wooden stake to drive it into the ground without risk of splitting. All these minute t things are much appreciated by those having occasion to cause the rapid making of small articles in immense number by the f first men at hand.[2] Nothing is more easy with the spikes found at Alesia, similar to those with which we attach our guides

on the boring mandrels of mine furnaces. By the aid of two of these staples a spike is fixed on the side of the round stake one foot long. Held at C and D, the iron cannot slip on the woodlin any direction, since its greatest dimension is at the middle," and the curvature strongly forces it against the wood." Perhaps two or three spikes were placed around the same stake; in the last case, it was necessary in forcing it into the ground to strike on its head by an intermediate block receiving the blows of the sledge; thus the object still better represents the meaning of the Latin text."

Note 1.p.548. Recherches sur le blocus d'Alesia. 1858. Leleux.

Note 2.p.548. By basing archaeological researches on practical observations, one can indeed arrive at serious discoveries, and M.Prevost is here perfectly correct, when he says that so many of these questions debated at such great length between archaeologists can really be solved only by practicians.

On their part the Gauls after the time of Cesar surrounded their camps and strong places by ditches excavated in the earth or even in the rock; the latter had vertical walls with a rampart inside. Thus were arranged the defenses of the Gaulish fortification still seen at the eastern extremity of Mt. Ganelon near Compiegne. The ditches of that place are 32.8 ft. in width with a depth of 9.8 ft. to 13.1 ft, and are separated from each other by a space of about 49.0 ft; a rampart 16.4 ft. high is built behind the second ditch. Great quantities of b boulders are laid on the bottoms of those ditches as obstacles.

The ditches of Gallo-Roman cities at the time of the invasion of the barbarians, such as those of Sens, Bourges, Beauvais, were very wide and were filled with water as much as possible.[1] The Gauls had further adopted the means of defense that the R Romans had employed against them, as Cesar himself stated; th those means must have been retained a long time. In the Roman du Rou, there is a question of ditches arranged in the new m mode, that had been frequently adopted in the 11 th century. (Old French poem).[2]

Note 1.p.549. The ditches of Sens were filled with water and had a width of about 88 ft.

Note 2.p.549. The Roman du Rou, verse 8893 et seq. This stratagem seems to have singularly pleased the historians of t that time; for they mentioned three times, viz:- 1, in 992 in

the battle of Conquereil between Conan, duke of Brittany, and Fulques, count of Anjou; 2, in the present case' 3, in the i invasion of Aquitania by Scandinavians in 1019. (note of M. A Aug. Le Prevost).

How could they excavate ditches wider at bottom than at top? That is difficult to explain, unless it be around the sides were shored. We see that these ditches were covered with brush and grass to conceal their openings.

The Normans surrounded their fortifications by very wide a and very deep ditches, sometimes with a palisaded covered way on the outer crest. The castle of Arques of Tancarville, and later castle Gaillard, still retain their ditches cut in the rock at the top of the precipice, which serves as a site for these fortresses. (Art. Chateau). Passages likewise cut in the rock lead from the interiors of castles to the bottoms of the ditches; they served especially to allow the garrison to go out ts attack the miners, attached to the bases of ramparts and towers, and to the precipices which bore them.

We have not seen walled counterscarps before the 13 th century, while after that epoch the ditches are nearly always walled around important fortresses, and their bottoms are paved with slabs around castles built with care. The ditch of t the keep of Coucy (beginning of 13 th century) is paved; the great ditch before the gate of the castle of Pierrefonds also (beginning of the 15 th century). At the city of Carcassonne, where remain considerable fragments of the walls of the counterscarp of the ditches at the eastern side (end of 13 th century). The counterscarp of the wide ditch that separates the castle of Coucy from its bailey, was walled (beginning of 13 th century). The ditches of the castle of Vincennes were walled after the rebuilding of that castle during the 14 th century; those of the Louvre were walled after Charles V.[1] Not only the castles of the cities were surrounded by ditches, but also the abbeys located outside cities, and even sometimes p parish churches.

Note 1.p.330. Souvol.

When artillery was employed to besiege places, the ditches were again enlarged, and men thought particularly of arranging the defenses to sweep them, covered ways to protect their approaches, low works to obtain a sweeping fire at the level of

the ground, cunettes to remove rainwater, dams and reservoirs to fill them, when streams and adjacent ponds permitted this. (Arts. Architecture militaire; Bastille; Bastion; Boulevard; Chateau; Porte; Siege). It was for the superior lord to regulate the extent and width of the ditches, and in certain cases he required them to be filled up. As for their maintenance, it was at the cost of the lord or at the expense of the vassals by special agreements. We find in a very curious collection published by M. A. Champollion-Figeac [2] the translation of a text in the Gascon language, that has for title:- "Also he o ordered it to be enclosed and armed against his enemies." [3] In this text, the passages relating to ditches are noted.

Note 2.p.550. Droits et usages etc. Paris. 1860. Leleux.

Note 3.p.550. Coll. Doct. Vol. CXLVII, folio 282. M. Champollion-Figeac does not give us the date of this text. From the nature of the defenses, it appears to be of the end of t the 14 th century.

"The manner of enclosing the city:- first, there should be all around it great, wide and deep ditches, so deep that water rises in them; and those places where water cannot be had, m must be made at bottom of the ditches a great number of "vosias", [4] covered by a layer of earth and grass; and after, there must be great and high walls with towers 53 ft. square for defense, and that the ditches be well cleared of grass and shrubs from the foot of the wall to the bottom. And at the gates and entrances, there must be drawbridges, and all the ways for entrance must be interrupted by great ditches in five or six places, except a small and narrow passage, which should be broken when necessary, so that no one can approach the gates on foot or mounted, nor bring fire in a little car, nor in anything, and to make a great number of "vosias" by the entrance ways. 1."

Note 4.p.550. M. Champollion-Figeac does not translate the word "vosias"

Note 1.p.551. It would seem that these "vosias" are little traverses or low cavaliers. Traces of those traverses are found terraced in the descent of the barbican of the city of C Carcassonne, and even in the ditches excavated along the north front of that fortress.

We have often found traces of these interruptions made acr-

across roads leading to the gates. Those breaks were equipped with barriers, and since the roads nearly always ran along t the ditches, so as to be swept in flank by the towers and curtains, the breaks extended into the enclosing ditch, so as not to serve as refuge for the besiegers; but these details are explained in Art. Porte.

The little cities or communes built in the second half of t the 13 th century in Guienne are surrounded by ditches with a wall; most of those little cities are perfectly regular, as well as their defenses.[2] In regard to the commune of Sauveterre, M. Leo Drayn in the excellent work, that he has published on Guienne militaire, gives the text of the privileges granted to that commune in 1283 by Edward I. In this Latin text,[1] we read the following relative to the walls and ditches.

Note 2.p.551. On this subject, M. A Champollion-Figeac appears to be astonished in his collection of "Droits," by what we have advanced on this fact (sufficiently proved by the fine researches of M. de Verneil and the works of M. Leo Drouyn, viz:- that the plans of the cities of Aigues-Mortes, Carcassonne, Villeneuve-le-Roy, Villeneuve-le-Archeveque, Sainte-Foy, Monpazier, Monsegur, Sauveterre, etc., were decreed in advance by the superior lords of the 13 th century, and he adds concerning the plan of Monpazier in Perigord:- "The author (of the Dictionnaire) gives even the plan of the lost city. But it is true that the author does not inform us whence he derived this plan of a city of the 13 th century." We have taken this p plan from where M. Champollion-Figeac couln have himself taken it, i.e., that of Monpazier, "a pretty littce city," says the Dictionnaire of M. Girault de Saint-Forgeau (Dordogne), Tot 28 miles from Bergerac, the chief place of the canton, f founded in 1284 under the direction of the lord de Buch, Jean de Grailly; well built and formed of wide and straight streets." There is in the work of M. Champollion-Figeac, in the midst of reproaches full of interest, when he cites ancient texts, many other singular interpretations. The learned compiler accuses us, for example, of allowing ourselves to be guided by our imagination on the subject of castles, wheu we give plans according to the existing monuments; among other things, he seems to ignore that castle Gaillard is still standiug in great part, that its ditches cut in the solid rock are not

changed at all; he pretends in citing our mutilated text, that at Roche-Guyon we have found only one postern of the 13 th c century, and that on that fragment we build what he terms retrospective theories; however tourists that descend the Seine can see not only the castle but the keep intact, that surmount it. To combat what he presents as theories and systems, and to emphasize in us numerous contradictions, M. Champollion-Figeac fills several pages of his book with quotations from t the Dictionnaire, incomplete quotations with intercalated commentaries, interpretations or assumptions, which are not worthy of serious criticism. There is no author, that one cannot make contradict himself by taking a part of a phrase here and another there, and connecting these fragments by the aid of comments. M. Champollion believes with the best faith in the world, that in the matter of monuments, France possesses only archives and libraries; he does not comphehend that one can distinguish the structure of the 12 th from the edifice of the 14 th century, without the help of the foundation documents. He does not at all admit classifications by schools, and he demands proofs from us. It is nearly as if one required the English to prove that they understand each other when they converse together. Learn English and you will have the proof.

Note 1.p.552. Published by the Comm. of Hist. Monts. of the Gironde. 1847.

"Item, we will that soldiers and masters, citizens or inhabitants of said city be exempt from all communal labors, except those of bridges, wells, roads and walls of the city, labors for which men in the vicinity of the place are held, without any doubt of concurrence. As for us, we are held to make the first enclosure of the city, and the said soldiers and masters must watch day and night during the execution of the works, the other neighbors in their turn are responsible for m misdemeanors committed by day or by night." Thus the enclosures, i.e., the ditches and ramparts were made by the lord under the supervision of the commune, around the markets or market towns founded by special privilege of the superior lord. The feudal lords opposed the establishment of these little communes, the bishops excommunicated the founders and the inhabitants; but these objections and excommunications did not prevent the cities from being erected.

The walls of Avignon, begun in 1349 and ended in 1374, were surrounded by ditches 65.6 ft. wide and an average depth of 13.1 ft. below the crest of the counterscarp. This counterscarp was not entirely walled, but to avoid undermining by freshets in the Rhone, the bottom of the ditch was paved with large cut stones.[2] The Rhone, Sorgue and a branch of the Durance in ordinary times filled a great part of these ditches.

Note 2.p.382. The pavement is found 9.8 ft. below the surface of the ground, when the present owners of the ground over the ditches cause a well to be dug.

FOUR. Oven for Baking.

In the cities of France, the superior lord permitted the e establishment of ovens for bread; this was a privilege of the lay or secular lords, or for the abbeys, who desired a profit from it. Those common ovens were heated by the owners of the privilege, and were established in buildings to which everyone could bring his bread and have it baked by paying a royalty. Sometimes these common ovens were established at the expense of a feudal lord, and were freed from all dues by the superior lord. certain cities obtained the privilege of building as many ovens as it pleased the citizens to construct. In the towers of fortified cities were established ovens, so as to allow the garrison in case of blockade to bake its bread without having recourse to the inhabitants or to the common ovens. Most keeps also possessed their oven. (Arts. Architecture Militaire, Chateau, Donjon, Porte, Tour).

Lime kilns, no more than ovens for bread, could not be established without permission of the sovereign lord.

FOURCHES PATIBULAIRES. Gibbets. Gallows.

"The local high justices," says M. A. Champollion-Figeac,[1] "could not erect as many gibbets as they desired to establish. The ordinance of king John of 1345 and 1346 appears to sufficiently indicate this. But the wise monarch Charles V added a new privilege for certain localities, that of having gibbets with two piers. The abbey of Cluny obtained this permission by favor in the month of September, 1360.[2] Do not omit a last fact, which will prove that it was not permitted to ornament these atrocious instruments of punish ent by other signs, than

the king desired to be placed there. The count of Rodez having placed his shield of arms on the top of a gallows established on place Carmes in that city, the seneschal of Rouerque was immediately informed that the king formally objected to its being placed there, and that the count would be arraigned before the high justice of the monarch. It is true that this placing by the count of Rodez represented in this case the taking possession of the high justice of the place; but it was very bad for a lord of Rouerque to choose that occasion to parade the blazon of his arms," that was a privilege; the evil was to use this if he had not the right.

Note 1.p.553. Droits et usages. p. 165.

Note 2.p.553. Coll. de chartes et diplomes, box 267.

In regard to this, and to prove to what point the king was jealous of his rights of jurisdiction, during the sojourn of the Popes at Avignon a notorious malefactor was pursued by the officers of the pontifical justice, and crossed the arm of the Rhone before the city, taking refuge in the island called du Mouton. The Pope's men landed there at the same time as the criminal, took possession of his person, and hung him on a gallows erected there by their order. The corpse of the man punished was buried after proper delay. These facts were not reported till long after to the officers of the king of France, who accused the Pope's men of having encroached on the seignorial rights of the king; the officers of the Pope alleged in their defense, that they had no intention to usurp the royal jurisdiction, but they believed that they had rid the country of a dangerous man. The royal judges did not insist; but so that this precedent could not be invoked later against the rights of their sovereign, they in their turn went to the island of du Mouton, there proceeded against the punished man, and after having held a regular trial, hung him again in effigy on the gallows with the arms of the king.[1]

Note 1.p.554. Information furnished by M. Achard, archivist of the prefecture of Vaucluse.

The right of high, middle and low justice belonged to feudalism; the great vassals holding directly from the sovereign infeoffed certain parts of their domains to vassals of lower rank; and these imitating them, likewise constituted new fiefs, whose sovereignty they reserved. At the same time both ceded

their right of justice over certain areas to the territory, however not without some reserves in that transfer, but limiting more or less the extent of the power that they granted.[2] The gibbets consisted of stone piers connected at the top by cross beams of wood from which were suspended the criminals; either when hung on the gibbets themselves, or after execution elsewhere, they were then exposed to the view of passers. The number of piers varied according to the rank of the lords; simple gentlemen as high justices had two, castellans had three, barons four, counts six and dukes eight; the king alone could have as many as he thought proper." He could also suppress gibbets, whose establishment he had permitted. In 1487,[3] "the king's attorney at the Chatelet went to various places in the provostry and vicinity of Paris to cause to be demolished the gibbets, carquans, ladders, and other marks of high justice, in consideration that king Louis XI had granted to several t the right of high justice, which was revoked by the edict of general revocation of all grants in a portion of the domain alienated after the death of Charles VII, which was issued by Charles VIII on his accession to the crown."

Note 2.p.554. Des anciennes fourches patibulaires de Montfaucon, by A. de Lavillegille. Paris. 1836. Techener.

Note 3.p.554. Comptes et ordinaires de la prevote de Paris. Sauval. Vol. III, p.421.

The gibbets, states Loyseau,[4] were placed in the midst of f fields, near the roads and on the hill. Indeed, many elevated places in France in the vicinity of abbeys and residences of lords have retained the name of justice or great justice.

Note 4.p.554. Traite des seigneuries. -- Jacquot, traite d des justices.

Certain gibbets were made of wood, composed of two posts w with cross beam at top and braces; but we do not have to occupy ourselves with those, which have no monumental character. Among famous gibbets, that can be regarded as edifices, it is necessary to cite in the first line the gibbet of Montfaucon. Sauval states,"that from the year 1188 and perhaps before, t there was a gibbet on the hill of Montfaucon,"and he adds," that it is a gentle elevation between the suburbs of S. Martin and of the Temple, in a place to be seen from some leagues around it. On the top is a mass of masonry accompanied by 16

piers,[1] to which leads a flight of stone steps of sufficient width, formerly closed by a good gate. The mass is a parallelogram, 12.8 to 19.2 ft. high, 38.4 to 44.8 ft. long and 32.0 or 38.4 ft. wide, terminated by a platform, and composed of 10 or 12 courses of great blocks of stone well bonded and cemented, rusticated or with sunk joints. The great square piers are 32 to 33 ft. high, made of 32 or 33 great stones with sunk joints or rusticated (with bosses), like the preceding, also well fastened and cemented, being arranged in two rows lengthwise and one crosswise. To connect them together and to attach the criminals, fixed on their caps are two great wooden beams passing between them, with iron chains in the intervals. At the middle was a cellar into which were apparently thrown the bodies of the criminals, when only the skeletons remained, or all chains and places were occupied. Now that cellar has fallen in, the gate of the steps is broken; of the piers scarcely three or four remain standing, the others being entirely or partly ruined."

Note 1.p.555. Satyre Menippe.

"To each his own is justice;
At Paris are 16 police officers;
At Montfaucon 16 pillars.
Each has its advantage.

16, Montfaucon calls you,
Tomorrow cry the ravens,
16 pillars of its chapel
Will be as many tombs.

Although Sauval does not tell us from what sources he obtained his information, different documents [2] establish the existence of the gibbet at Montfaucon, at least from the 13 th century. -- An agreement of the month of September,1233,between the prior of S. Martin-des-Champs and the chapter of Notre Dame contains the following passage (Latin). -- An act of sale of the month of June, 1249;- (Latin).[3] It results from these two documents, that in the years 1233 and 1249, adds M de Lavegille, there existed a gibbet on the area of the common manor; now the gibbet of Montfaucon being found just in that manor, he evidently speaks of that. In the romance of Berthe aux grans pies, which dates from about 1270, there is mention of a certain Tibot hung at the gibbet of Montfaucon. There is

then reason to believethat Pierre de Brosse or Enguerand de M Marigny, to whom are attributed the building of the gibbet of Montfaucon, only repaired or rebuilt it. The work of stones cut with bosses mentioned by Sauval would cause the belief, t that this edifice was entirely rebuilt at the beginning of t the 14 th or the end of the 13 th centuries, that sort of masonry being then much used for civil structures. This monumental gibbet was situated beside the old road of Meaux, not f far from the barrier du Combat.[1] As M. De Lavillegille observes, the 16 pillars of the edifice of Montfaucon were still connected (which Sauval does not explain and could not clearly indicate,(since in his time the gibbet the gibbet was ruined) by intermediate cross beams of Wood. Louis X "commended Engaerrant to be hung and strangled, to the highest wooden cross beam of the gibbe of Paris. Paviot was punished likewise, except that he was hung beneath Enguerrant." [2] The tapestry of the city hall of Paris (plan of Paris) indicates the gibbet of Montfaucon with three wooden cross beams. Further, Sauval in his Comptes et ordinaires de la Prevote de Paris,(Vol. III,p.278), gives the following passage, which is important (1425, Charles VII).

Note 2.p.555. Des anciennes fourches patibulaires de Montfaucon, by A. de Lavillegille.

Note 3.p.555. Archiv. de l'empire. Sect. dom. S. 218. Titles of the fief of the common manor formerly possessed by the chapter of Notre Dame of Paris.

Note 1.p.558. See plan of Verniquet.

Note 2.p.558. Goguin. Grandes chroniques de France.

"Works and repairs made in the grand gibbet of Paris. To --, for having made in the said gibbet the requirements hereafter; i.e., for having shoveled and cleared the earth around the w walls that enclose the said gibbet, forty ft. along its walls; and if they have been cleaned and whitewashed. Place within that enclosure,:and also have whitewashed all the said walls of the pillars and beams of the said gibbet, both within and without, with lime and glue, I believe (chalk), and scaffolds, labor of workmen, do this, etc."

"To --, stonecutters and masons for having removed several old blocks (of stone) that were broken and cracked, both on the angle piers and the intermediate piers, and the walls enc-

enclosing that gibbet; and instead of them have brought and set 40 double blocks, and a "carton" of white through stones, and filled several holes in the exteriors of said walls, and filled with plaster all the joints of said walls, and for having removed and replaced all the stone cornices of the said walls around the said gibbet, and having made two side walls at the entrance of the said gibbet, raised and reset the steps of cut stone at the said entrance, and replaced 48 old beams, that had been removed and thrown down from the said gibbet, and set 48 others that are new, and set two caps of stone on one of the intermediate piers in place of two others, that w were worn and injured by water and frost, for what they have done, they should receive, etc."

In 1466 we read in the same Comptes (p. 389) this passage; "To the great gibbet of Paris were fastened and nailed 52 iron chains to serve for hanging and strangling malefactors, that have been and will be placed there by the decree of justice." In 1485 the gibbet of Montfaucon threatened ruin, for the Comptes de la prevote contained this item (p. 476); "and also was made a gibbet adjoining the great gibbet, that is in danger of falling from day to day."

The condemned were hung to the cross beams by means of ladders which they had to ascend, preceded by the hangman. "Eight great new ladders extend above each cross beam so that the s sufferer had his head at the desired height; the hangman mounted to the top of the laddeer, passed the chain around his neck, and descending, removed the ladder."

Note 1.p.557. Comptes et ordinaries. Sauval. Vol. III. p.532.

According to the description of Sauval and several graphic documents,[2] here is the plan (1) at A of the gibbet of Montfaucon. Considering their height (at least 32.8 ft.), the piers could not have been less that 3.3 ft. square; the 16 piers b being "ranged on the breadth and one lengthwise," must leave 15 spaces between them of 4.9 ft. on the larger and of 3.9 ft. on the two shorter sides. Then there could be but one chain to each cross beam at the short sides and at most two for t those of the large one. The cross beams being three in number, that made 60 chains. This explains the number of 52 new chains furnished in 1466; perhaps there remained several old ones that could serve. The cross beams were necessarily doubled,

both to fasten the chains as well as to allow the hangman on them, and to properly shore such high piers. Then there were 90 cross beams or only 60, if the lower beams were single. T The furnishing of 48 new cross beams in 1425 therefore is not surprising.

Note 2.p.557. Tapestry of the city hall, view of hospital S. Louis, 1641. Chatillon Chalmeis. View of hospital S. Louis. Perelle.

The height of the piers (admitting that the tapestry of the city hall indicates one cross beam too many) can leave no doubt of the number of those cross beams.men would not have erected piers more than 32.8 ft. high to place but one upper cross beam and a single intermediate beam, for then would have been lost places in height; now it is certain that they held to having the greatest possible number of them.

One sees at B on the plan A the cellar indicated by dotted lines, with its opening C, intended for casting down the corpse and remnants, its door for removal being at Da At E is d drawn the section made on a b and showing the steps with the side walls repaired in 1425, and the portal fitted with leaves, that Sauval mentions. The ladders were raised at the time of the execution, and they were probably placed on the platform.

Sometimes the cellar intended to serve as a receptacle for the remains of the executed was so filled, that the platform was strewn with fragments, the chains suspended skeletons, so that it was necessary to make a general removal and to bury the decayed or dried remains. For example, this operation was necessary, when it was required to replace the beams, that o occurred quite frequently.

At the foot of the hill on which rose the gibbet of Montfaucon on the West, had been erected a stone cross, some authors state, by pierre de Craon in memory of the decree that this lord had obtained from Charles VI in 1396, by which confessors were granted to the condemned. But this cross would seem rather to have been placed there in 1403, after the execution of two scholars of the University ordered by the provost of Paris. In fact, Monstrelet [1] reports the case thus; "M. William of Tigouville, provost of Paris, caused to be executed two clerics of the University; i.e., one named Logier of Monthilhier, who was a Norman; and the other named Olivier Bourgeois, who

was a Breton; who were charged with having committed several thefts in different cases. And because notwithstanding they were clerics, and that when taken to the gibbet they cried lo loud and clear, "clergy"; so as to be rescued; yet (it is said) that they were executed and hung on the gibbet; and then by t the charges of the University the said provost was deprived of all royal office. And that he was condemned to erect a cr-oss of cut stone, great and high, quite near the gibbet on t the road from Paris; on which were carved the images of those two clerics. And besides they were taken down from the said gibbet, and placed on a cart covered by black cloth; thus be-ing accompanied by its sergeants and other persons carrying lighted wax candles; they were taken to S. Mathurin and there restored by the provost to the rector of the University."

Note 1.p.559. Chroniques. Chap. 12.

We give (2) a view af that edofice on the front side facing the southwest. The steps being understood to be placed at the rear, the condemned were brought on the platform after having gone around the massive masonry base. At the bottom of our Fig. is placed the cross of William of Tigouville, also indi-cated in the tapestry of the city hall.

Fig. 3. presents the entrance side of the gibbet.

It does not appear that there existed on the territory of France other gibbets with such a monumental appearance. This was not the only one at Paris; there existed a gibbet outside gate S. Antoine, one on the land of the city behind the bish-op's palace, one on the site occupied today by the western end of place Dauphine, one at Champeaux, one behind the gardens of Petits-Augustins, quite near the top of Rue S. Benoit, and that was on the lands of the abbey of S. Germain-des-Pres. The last gibbet, like many others, consisted of four stone posts with four cross beams of wood. It is represented in the tapestry of the city hall and in the great plan of Merian. Others again were composed of two piers with a single cross beam, or of t three piers set at the angles of an equilateral triangle with three crowning cross bars. The hideous appearance of these ed-ifices, and the horrible odor exhaled from them, did not pre-vent the establishment of wineshops, tea-gardens, and places of debauchery in their vicinity. (Old French poem). [1]

Note 1.p.561. Lo Repeu faicte oupres Montfaucon. Poem attrib-

attributed to Villon. Edit. Jonnet.p.292. 1854.

"Not far from Montfaucon," says M. de Lavillegille,[2] "is p found another smaller gibbet, that bears the name of Montigny. Built and demolished several times, it seems to have been intended only to supplement temporarily the great gibbet, when that required some repairs. The first mention of the gibbet is in the year 1328. It no longer existed at the beginning of the 15 th century, since in 1416 it was necessary to construct a temporary gibbet, while awaiting the work then being done at Montfaucon." That gibbet consisted of four wooden posts 1 ft. square and about 20 ft. high, their feet set in a supporting wall 2 ft. thick and of about the same height. Four cross beams connected the heads of the four posts.[1]

Note 2.p.561. Les anciennes fourches patibulaires.

Note 1.p.5_2. Sauval. Vol. II. p.612. -- Felibien. Vol. I, p.584. Pieces justificatoires. B.

Gibbets served as places for exhibiting the condemned executed at other places, and that had even not been hung. The bodies of decapitated persons were placed in sacks; these were also exposed on gibbets, suicides, and effigies representing persons condemned in contumacy. The corpse of admiral de Coligny was suspended by the feet on the gibbet of Montfaucon. L'Etoile reports that Catherine de Medici, "to please her eyes, went one evening to see it, taking there her sons, daughter and son-in-law." Since then these gibbets rarely served for executions or exhibitions. Still Sauval states that he s saw several corpses there still, although that edifice was i in ruins.

Gibbets not only served for hanging men, but criminals were also suspended there, particularly hogs condemned to that sort of punishments by judgments and orders made for having devoured children. (On this subject see the pamphlet of M. E Agnel. Curiosities judiciaires et historiques dumoyen age. Paris. Demoulins. 1858). In such a case the judicial formalities of the time were scrupulously followed, and it was the custom to hang the condemned in their clothes, and an animal was clothed when led to the gibbet. "In 1386 a sentence of the judge of Falaise condemned a sow to hang for having killed an infant. That sow was executed on the place of the city in man's clothing."[2]

Note 2.p.562. Curios. judic. M. E. Agnel.

c

In 1314,[3] a bull that had killed a man was judged and hung on the gibbet of Moisy-le-Temple. There was an appeal from t the sentence. The judgment was found just; but it was decided that the count of Valois had no right of justice on the territory of Moisy, and that his officers should not have executed it. [4]

Note 3.p.382. Carlier. Histoire du duche de Valois. Vol. II. p. 207.

Note 4.p.5.2. Saint-Foix. Essais hist. sur paris. Vol.V.p. 100. 1776.

FRISE. Band. Frieze.

A running ornament filling a horizontal course under a band or cornice. In Roman architecture by frieze is understood the plain or decorated course found between the architrave and c cornice. The architecture of the middle ages no longer using the entablature of the antique orders, does not have friezes, properly speaking. However, the name of frieze in Romanesque or Gothic architecture is given to bands, when they are ornamented by sculptures. (Arts. Bandeau; Corniche; Sculpture.

FUT. Shaft of Column.

The part of the column between the base and the capital. ((Arts. Colonne; Construction).

End of fifth Volume.

TABLE OF CONTENTS

RATIONAL DICTIONARY

of

FRENCH ARCHITECTURE

From XI to XVI Centuries

By

EUGENE EMANUEL VIOLLET-LE-DUC

Government Architect

Inspector General of Diocesan Edifices

Volume VI

From Gable to Ouvrier

Translated by N. Clifford Ricker. D. Arch

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UNIVERSITY OF ILLINOIS

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GABLE. Gable. Pediment.

A carpentry term applied to masonry. There is still an association of carpenters to which is given the name of "Gavauds," and in Berry a man with legs bowed outward is called a "gavaud." The gable was originally the continuation at their apex of t two inclined timbers. The gable of a former comprises two rafters fastened to the end of a ridge, their feet resting on the ends of two plates. (1).

We have seen elsewhere (Arts. Cathedrale; Construction), t that at the end of the 11 th century and beginning of the 12 th, there were rebuilt in the cities of the royal domain and of the north of France, all the cathedrals and a great number of parish churches. Although on beginning these edifices resources were abundant, when they reached the level of the high vaults, money came to be lacking, or at least it could only be collected much more slowly. Then it was necessary to employ temporary means for covering, that permitted the sheltering of the constructions completed, as much to avoid injuries caused by rain and snow as to devote these edifices to worship. Besides in very large monuments, for example like the cathedral of Amiens, it would have been imprudent to erect the piers, the great windows, the wall and eave wall surmounting them, to set the upper carpentry on these isolated walls, or rather on this scaffolding, without turning the great vaults and the flying buttresses that abut them; for the stability of this kind of edifice only consists of a system of equilibrium or opposed pressures, whose mechanism has been sufficiently expplained in Art. Construction. Thus it was necessary to build the high vaults in parts, to await the gathering of the resources required to erect the eave walls of the great carpentry. Then was temporarily covered each portion of the completed v vault by the simplest and cheapest method; over the side arches were erected wooden gables with apexes on a level and a m ridge placed on posts on the axis of the main roof. These gables were connected with that ridge, the rafters were set, battens and tiles were placed over the whole. (2; see sketch A).. The constructors took care to reserve at the imposts of the vaults basins endin gargoyles casting the water directly on the ground, as at the S. Chapelle of Paris, or into the channels of the flying buttresses as at Notre Dame of Amiens. (Sketch

B at C). Thus they could wait several months, even some years, before building tympanums over the windows, eave walls and the great carpentry; the vaults were covered, and the masonry had nothing to fear from the rain, snow or frost. As soon as the accumulated collections permitted continuing the work, between these gables and without destroying the temporary coverings were built the piers D and portions of the eave wall G; on t these parts of the eave wall, whose tops reached the ridges of the temporary covering, were placed the plates of the final roof (Sketch A at H), the great carpentry was placed and covered, and this being completed, the temporary covering underneath was removed with the wooden gables, and the tympanums were set on the side arches or archivolts of the windows, as well as at the ends of the cornices and eave wall still lacking. Pipes arranged in the piers D (See sketch B) led the water from the gutter E to the gargoyles C, which were thus utilized with the temporary and final covering. But the eye had been accustomed to see these wooden gables over the side arches of the vaults, interrupting the horizontal lines of the c cornices and eave wall. When they were removed, the crown of the completed edifice must appear cold and poor; the architects then had the idea of substituting stone gables for these temporary constructions, whose effect was pleasing. That is what Pierre of Montereau did at the S. Chapelle of Paris after 1245.[1] That example was frequently followed about the end of the 13 th century, notably around the choir of the cathedral of Amiens; then later at Cologne.

Note 1.p.4. Art. Fenetre, Fig. 19.

During the second half of the 13 th century, stone gables thus became a decorative motive frequently employed. The north and south portals of the transepts of the cathedral of P Paris, whose construction dates from 1257, are surmounted by gables, that do not fulfil any useful functions, but which terminate the archivolts by great partly perforated triangles, breaking the monotony of the horizontal lines of these immense gables.

Here (3) is the gable of the southern portal of Notre Dame of Paris. The balustrade of the gallery passes behind that g gable, which is nothing but an isolated wall 13 ins. thick. Other smaller gables surmount the niches accompanying this p

portal, and this form of great serrations at the base of the edifice. We have stated elsewhere [2] how the constructors of the middle ages employed these ornamental gables to load the side arches and prevent them from warping.

Note 2.p.5. Art. Construction, Fig. 108.

The three portals of the cathedral of Amiens are very deep, comprised between great projecting buttresses, and are covered by gable roofs closed by solid gables, giving almost a right angle at top, only ornamented by rampant crockets and a crowning cross-flower. At the cathedral of Laon was adopted the s same arrangement; but the architect of the cathedral of Rheims about 1260, while retaining the principle, desired to give unequaled richness to the gables of the three portals.

The gable of the middle porta, (4) represents the coronation of the Virgin at colossal size, sarmounted by a series of canopies ascending like steps to the apex of the triangle. The statuary is in the round; the projections are pronounced to the point of almost causing the primitive form of the gable to be forgotten. Here the lines of the architecture are destroyed by the sculpture.

While the 14 th century gave to the gables great richness of details, yet it always had as a principle to leave to the lines of the architecture their necessary importance. The gable of the portal of the Calende at the cathedral of Rouen is one of the best composed among those remaining to us from that epoch. (5). It is entirely opened above the gallery, and decorated by reliefs in the foils below5 its copings are decorated by delicate tracery, that replaced the crockets, as on t the south portal of the cathedral of Paris.

In the 15 th century the copings of the gables became still steeper, thicker, more loaded by mouldings, and the internal tracery is more open and lean. At the end of the 15 th century the copings of gables often form concave curves above the archivolts like elongated recurved arches. (Arts. Contre-Courbe; Construction, Figs. 106, 108; Fenetre, Figs. 19,26; Fleche, Figs. 4, 6; Lucarne; Pignon).

GALERIE. Gallery.

A level covered passage opening to the interior or exterior, serving for communication from one place to another, for pass-

passage at the different stories of the edifice; it is rather the monumental appearance that the greater or lesser height, that gives the name gallery to thatrpassage. The term gallery carries with it the idea of a walk, narrow in comparison to its length, but decorated with a certain richness. The name of gallery is also given to every service passade (corridor), also quite narrow, but very prominent and forming a part of t the architecture of an edifice. One speaks of the gallery of the kings at Notre Dame, the gallery of the side of the cathe-dral of Rouen, although this last gallery is only a very bad corridor. As for the galleries surmounting the side aisles of churches, archaeologists have agreed to give them the name of triforium, which we retain without discussing the value of t the term.

We shall them divide galleries into service galleries contr-ibuting to the external or internal decoration of monuments, and galleries for walking (corridors) in castles or public or private edifices.

The architects of the middle ages established in their great monuments service corridors at different heights in order to make the oversight and maintenance easy. The high facades of cathedrals, for example, were divided into several stories by galleries, that allowed communication from the interior to t the exterior, maintain the surfaces, repair the glass of the rose window, and at need to decorate the facade by hangings d during great ceremonies. Our French cathedrals in the north, built about the beginning of the 13 th century, whose facades have been completed, are decorated by superposed galleries. The facade at Notre Dame of Paris, which was erected between the years 1210 and 1225, presents over the portals a first g gallery, very rich, whose intercolumniations are filled by co-lossal statues of the kings of Judah. That gallery is an act-ual portico covered by a ceiling of thick slabs. Above is the gallery of the Virgin under the rose window; that is not cov-ered and is merely a terrace with a balustrade. A third galle-ry in the form of a very slender and very rich portico enclo-ses the bases of the two towers and connects them. On the fac-ade of the cathedral of Amiens over the three portals is a c covered service gallery, richly ornamented by arcades and lit-tle columns; the gallery of kings surmounts it, and this supp-

supports a terrace as at Paris. At Rheims at the base of the two western towers and over the central rose window as the uncovered gallery called the Gloria. From that gallery at certain festivals of the year, before the people assembled on the place, the clergy of Notre Dame intones the Gloria in excelsis. A long series of colossal statues of kings surrounds the base of the gable andthe towers above that terrace. At Notre Dame of Chartres is seen a similar arrangement, but in much simpler proportions, extending only between the two towers. One can thus obtain an idea of what these galleries are in the edifices of the middle ages. We shall enter into more complete details relating to these important parts of construction.

GALERIES DES ROIS. Galleries of Kings.

The oldest gallery of kings to which can be given that name, because at the same time serving as a passage for the service of decoration, as that of the facade of Notre Dame of Paris; a date cannot be assigned to it later than 1220. That consists of a series of piers (1) supporting a stone ceiling on corbellings, and before each of these is placed a column. The k kings are placed at A and are sheltered by an arcade supported by columns. Fig. 2 gives this gallery in section; the statues of the kings are placed at A, a little behind the bases of the columns, and at B is a service passage behind the strengthening piers placed behind the columns. The terrace called that of the Virgin is at C. Fig. 3 presents the external appearance of the gallery. By its style of composition, that gallery is certainly the most beautiful of all those existing on the facades of our French cathedrals. One will note how this arcade, low and simple in general composition, brilliant in details, forms a pleasing enclosure around the statues of the kings. As for its effect on the entirety of the facade, it is excellent. Yet the gallery of the kings of Notre Dame of Paris traces a rich and solid zone above the three portals, and very happily crowns them. The statuary is well at the scale of the monument, appears grand, without thereby lessening the architectural members.[1]

Note 1.p.10. See 7 th Entretien sur l'orchitecture, the entirety of this facade.

The style of the gallery of the kings of Notre Dame of Rheims is quite different. At Rheims this gallery replaces that

at Paris which surrounds the bases of the towers; it is merely a decoration and does not furnish that continuous passage. The construction dates from the end of the 13 th century, and its statuary is mediocre. This gallery being given in detail in the work of M. Gailhabaud,[1] it does not seem necessary to reproduce it here.

Note 1.p.13. L'Architecture du Ve au XVIIe siecle et les arts qui en dependent. Vol. I.

As for the cathedral of Amiens, the arrangement of its gallery of kings is very beautiful. Like that of Paris, it surmounts the three portals; but at Amiens between the gallery of the kings and the gables of the porches is an intermediate gallery of the most beautiful style of the art of the 13 th century. (About 1235). The lower gallery (4), that of the kings and the upper terrace A are all practicable and communicate with the lower stories of the towers. Behind the lower gallery open great windows without tracery, which lighted the central nave through another internal gallery, before the placing of the gallery of the great organs. Other short windows are opened behind the gallery of the kings; these look on a second g gallery over the lower gallery. The plan (5) explains that beautiful arrangement, which unfortunately is now concealed by the organ front. One notes (Fig. 4) that the lower gallery re rests on piers composed of three columns grouped before a pilaster; discharging arches richly ornamented by cusps and sculptured animals, on the fronts of the imposts rest on these piers. Between these discharging arches the arch is free; it is a simple tracery supported on a monolithic column and maintained only under the intrados of the arch by two projections hanging from the two upper voussoirs of the circle. Thus the architect did not have to fear the rupture of the open tracery under the load orby settlement of the upper parts. A single course of stone separates the lower gallery from that of t the kings. The stone slab ceiling of the uncovered upper gallery rests on the lintels, that form the imposts of the arcade of the kings. Each of these imposts is cut with a channel and sends the water from the slab ceiling to the outside through the heads of gargoyles, that ornament the faces of the abacuses.

GALERIES DE SERVICE DES EGLISES. Service Galleries of Churches.

With the gallery of the kings of the cathedral of Amiens, we see one of those both service and ornamental galleries, th that break the vertical lines of the facades. During the 13 th century these galleries are tolerably varied in their design and details; they take a considerable importance like the great open gallery at the base of the towers of Notre Dame of Paris, and that of the portal of Notre Dame of Dijon, or where they are low and stumpy porticos, like the gallery of the facade of Notre Dame of Laon.

The question of art and of proportions in this case dominate the question of service. Yet those galleries always possess utility. In their grang edifices, the architects of the middle ages established means of easy passage at different levels, s so as to be able to oversee and maintain the structures, the roofs and the glass, without being compelled, as one is today, to erect costly and injurious scaffolds, because of the injuries they cause to the sculptures and the delicate parts of the architecture. The two superposed galleries of the western facade of the church of Notre Dame of Dijon (13 th century) are remarkably beautiful in composition and sculpture. We give (6) one of these galleries, surmounted by a high frieze of o ornaments in the fashion of metopes placed between projecting figures. These galleries were destined to connect the bases of the two towers, that have never been erected.

On the exteriors of the Rhenish churches of the 12 th century there frequently extend below the roofs galleries for passage, particularly around the apses. These galleries were then made at the expense of the springings of the half domes of t these apses; they are low, composed of little columns supporting round arches, and they impart richness and lightness to the crowns of those edifices.

We observe that this system is sometimes adopted in the south of France, notably in religious monuments built of brick. Thus at the top of the church of the Jacobins at Toulouse is seen a service gallery, an actual covered gallery, placed beneath the gutter, and that opens into the turrets at the angles of the edifice, and permits passing around the structure near the summit of the vaults. That gallery (7) is lighted f from outside through the round openings B, allowing the examination of the vaults be the little glazed windows C opening

under the side arches; it is supported on great discharging arches D turned from one buttress to another, and perfectly sheltering the glass windows placed at E. All this construction is of brick, and presents a most monumental appearance.

In the interiors of the great Gothic vaulted naves are found above the triforiums, particularly in Burgundy, service galleries passing behind the side arches of the vaults. We see galleries of this kind in the interior of the church of Notre Dame of Dijon, Notre Dame of Semur, of S. Etienne of Auxerre. (Art. Construction, Figs. 78, 79 bis, 88). In the churches of Champagne and of Burgundy, we likewise see service galleries arranged in the side aisles of chapels, above the arches of the ground story, under the window sills.(Art. Construction, Figs. 86, 87).

A gallery of that kind, very beautifully composed, exists around the side aisles of the choir of the abbey church of S. Jean at Sens.[1] Beneath the side arches of the vaults of of these side aisles open triple windows; the gallery passes through their piers as it passes behind the piers bearing the vaults. (8).

Note 1.p.16. Now chapel of the hospital.

We cannot omit here the service galleries that intersect at about two-thirds the height of the side aisles and piers of the nave of the cathedral of Rouen, that pass on arcades around these piers on the side next the side aisle. This singular arrangement, whose motive can scarcely be explained today, seemed quite necessary then (about 1220), for men to believe it necessary to turn arches beneath the archivolts and to give to corbels surrounding the piers considerable importance a and richness. The perspective sketch (9) gives at A the plan of this gallery at the level B of the springing od the arches. At C must have existed a balustrade, whose supports are in p- place, but we believe has never been placed. The nave of the church S. Etienne-du-Mont at Paris, which dates from the 16 th century, presents an analogous arrangement. These galleries can only aid the hanging of the naves on festal days.

On this subject, one will also observe how many architects of the middle ages bring variety into the entirety as in the details of their conceptions. Their flexible methods always give them novel means, when a need is to be satisfied, to ful-

fulfil the different parts of a programme.

GALERIES DE SERVICE DES PALAIS.

Service Galleries of a Palace.

There are frequently established in the castles and palaces of the middle ages service galleries opening into the principal rooms. (Art. Construction, Figs. 119, 120). These galleries serve one or several stories. At the tops of fortified b buildings of the 14 th and 15 th centuries, they become covered galleries suited for defense, and were then equipped with machicolations. (Arts. Chateaux; Donjon; Machicoulis). We see in some castles the remains of these service galleries; they are sometimes made in the thickness of the walls themselves, pass through the buttresses, as in the example cited here, (Art. Construction, Fig. 120), or are supported on corbellings.

In the southern building of the palace of the Popes at Avignon, on the side next the court is found a pretty gallery of the 14 th century, that gives entrance to the halls of the second story. We reproduce (10) the cross section of this gallery with pointed vaults, and lighted by little windows opening on the court. The ceiling of this gallery served as au u uncovered gallery with battlements and decorated by pinnacles.

This sort of service galleries end at stairs and are combined with them. Toward the end of the 14 th century the width of these corridors was increased, and at the end of the 15 th century men came to make them actual promenades. That custom was definitely adopted in the 16 th century, as one can see at the chateausof Blois, Fontainebleau, (gallery of Francis I), Chambord, etc. Then they were enriched by paintengs, sculptures, and furnished with benches. Galleries thus frequently replaced the great hall of the feudal castle.

Sauval relates[1] that "in 1432 the duke of Bethfort (Bedford ?) caused to be built at the palace of Tournelles a long gallery 115 ft. long and 9.6 ft. wide; it was named gallery of the guards, because the green guards were painted there; it was covered by a ceiling painted with his arms and devices, roofed with tiles set in lime mortar and cement, and surrounded by six banners enriched by his arms and those of his wife. But in past centuries," adds this author, "there was no mansion more magnificent than that completed by Charles V in the apartment of the queen at the palace of S. Pol." That gallery

was painted from the wainscot to the vault, so as to represent a grove full of plants, fruit trees and flowers, among which children played, the vault was white and blue." Besides that," continues Sauval, "king Charles V caused to be aose painted a little corridor through which the queen passed to come from here oratory to the church of S. Paul. There at both sides a number of angels held a curtain of the liveries of the king; of the vault one could best speak op an azure sky, on which were represented descending a legion of angels, playing on instruments and chanting the anthems of Our Lady. Further, the sky, both of the corridor and of the hall were German blue (ultramarine), worth 10 Paris livres the pound, and the whole cost 26 crowns."

Note 1.p.10. Hist. et antiq. de la ville de Paris. Vol. II. p. 281.

The corridors of private houses, intended to serve several connected rooms, were generally arranged in form of a shed r roof with a portico in the ground story, adapted to shelter a store of wood for warming, for drying linen, etc. These galleries were lightly built of wood on stone columns or posts, and had only the width of the corridor, 3.3 to 4.9 ft. (Art. Maison).

GALETAS. Attic. Garret.

A story of a house under the roof, intended for keeping provisions and hanging linen. Many houses of the middle ages, especially in southern France, where the need of coolness is f felt, have attics under the roofs. (Art. Maison).

GARDE-CORPS, GARDE-FOUS. (Art. Balustrade).

GARGOYLE. Gargoyle. Spout.

It was only about the beginning of the 13 th century, that were placed gutters and consequently gargoyles at the edges of roofs. Until then the first centuries of the middle ages, water from roofs or terraces fell directly on the public street by means of the projection given to the cornices. (Art. Chenau). At the cathedral of Paris in the time of Maurice de Sully, i.e., the completion of the choir in 1190, there were neither gutters nor gargoyles; later on the same edifice about 1210,

the water in the gutters ran over the projection of the crown moulding by means of grooves sunk at certain distances. We see gargoyles appear about 1220 on certain parts of the cathedral of Laon. These gargoyles are wide, not numerous, composed of two courses, one forming the groove and the other the cover. (1). But laready these gargoyles affected the form of fanciful animals, rudely cut, as if to allow their construction to be seen. The architects of the 13 th century soon recognized, t that there was a considerable advantage in dividing the water-spouts. That indeed avoided long slopes in the gutter, and reduced each stream to a very small streamlet of water, not able to injure the lower construction. Thus the gargoyles were multiplied, and in increasing them they could be cut finer and more slender, and the sculptors took possession of those projecting stones to make an ornamental motive for the edifices. The diversity of forms given to gargoyles is prodigious; we do not know two of them alike in France, and our monuments of the middle ages are covered by them. Many of these gargoyles are masterpieces of sculpture; there is an entire world of animals and persons composed with great energy, alive and boldly cut by skilful and assured hands. These beings are skilfully attached to the crown mouldings, belonging to the architecture and give to the outlines of the edifices a particular character, marking their salient points, accenting the heads of the buttresses and emphasizing vertical lines. One can judge of the skill of architects and sculptors in the combination and execution of these spouts by the difficulty experienced in combining and executing them. In modern imitations made on Gothic edifices, it is very rare to see gargoyles, that are happily joined to the architecture; they are either badly placed, heavy or too slender, of soft forms, poor in invention or without character; they do not have that real appearance so remarkable in the old examples; they are impossible beings, o often ridiculous, gross caricatures without style.

Certain limestones of the basin of the Seine, like the "clinquant" lias, lend themselves marvellously to the sculpture of these long blocks of stone projecting from the structures. There was indeed necessary a material firm enough to sufficiently resist in these conditions all causes of destruction, that hasten their ruin. Thus it is at Paris or in the provinces

where is found the lias, as for example at Tonnerre, that one can also collect the most beautiful examples of gargoyles. Be Besidesthe school of sculpture of paris in the middle ages c certainly has an incontestable superiority over the adjacent provinces, particularly in what concerns statuary.

Gargoyles are systematically employed at Paris about 1240; at Notre Dame we see appear on the upper cornice about 1225 g gargoyles, still short, but already cut by skilful hands.(2). Those placed at the ends of the channels of the flying buttresses of the nave, and that are nearly of the same epoch, are already longer and more slender, relieved by corbels that allow them to be given great lengths from the face of the buttress. (3).

At the S. Chapelle of the palace at Paris, the gargoyles are more slender and more developed; these are not only the busts of animals, but are entire animals attached to the upper crown moulding by their paws; their heads are diverted to throw the water as far as possible from the angles of the buttresses. (4). Some of these gargoyles were evidently sculptured by c consummate artists.

We have indicated in Art. Gable, how the Gothic constructors when they built the great vaults of the naves, arranged t temporarily basins in the spandrels of those vaults, with external gargoyles to throw the rainwater from the flying buttress until the completion of the permanent roofs. These temporary gargoyles themselves become permanent, when the upper gutters were placed, by means of a nearly vertical duct descending from the gutter to the gargoyles. Here (5) is one of those gargoyles with double end, taken from the upper part of the cathedral of Amiens. (About 1235).

The gargoyles are doubled at each side of the buttresses as at the S. Chapelle of Paris, as around the hall of the synod of Sens, and around the chapels of the choir of Notre Dame of Paris; or they cross the axes of these buttresses, as at S. Nazaire of Carcassonne and in so many other edifices of the 13 th and 14 th centuries, and then they rest on a corbel(6); or they rests on the heads themselves of those buttresse, as around the chapels of the choir of the cathedral of Clermont. (7). (End of 13 th century).

About that time the composition of gargoyles becomes more c

complicated, that human figures often replace those of animals, as may be seen in the last example, which shows us a winged demon appearing to carry off a small nude figure.

There exists around the monuments of this epoch a good number of gargoyles, that are veritable pieces of statuary. Church S. Urbain of Troyes has at the tops of the buttresses of the apse very remarkable gargoyles; we give one of them.(8).

During the 14 th century the gargoyles are generally long, already slender and charged with details; in the 1, th century they become yet more slender and take a character of strange ferocity. Although the details are refined and often too numerous, yet their mass retains its frank charm and an energetic outline; the paws and wings of the animals are properly attached, and the heads are studied with care (9, 9 bis). These important parts of the sculpture of the middle ages have always been treated by skilful hands; they reserve till very late their original character, and yet in the first times of the Renaissance are seen on the edifices gargoyles, that retain the style of the 15 th century. Only during the second h half of the 16 th century did the sculpture absolutely reject the old forms given to the ejectors to adopt figures of chimeras recalling certain antique figures, consoles, or simple stone pipes in the form of spouts.

During the middle ages gargoyles were not always sculptured; sometimes in places where not exposed to view, the gargoyles art only blocket out. There are a great number of that sort that assume a very simple form (10).[1] gargoyles are common in Ile-de-France, Champagne and on the banks of the lower Loire; rare in Burgundy, the centre and South of France; or if found on the monuments beyond the Loire, this is because they belong to edifices erected in the 13 th, 14 th and 15 th centuries by architects from the north, like the cathedrals of Clermont, Limoges, Carcassonne (S. Nazaire) and Narbonne. Where hard m materials are not common, as for example in Normandy, gargoyles are short and rarely sculptured, or are entirely wanting, the water descending from the roofs without gutters.

Note 1.p.27. From Notre Dome of Paris.

Lead gutters placed on civil or religious edifices also had their gargoyles of metal. We have very few today of that sort from an epoch before the 16 th century. Here is one (11) to be

seen at the corner of a house at Vitre; it dates from the 15 th century, and is made of hammered lead (Art. Plomberie). We know no gargoyles of the middle ages of terra cotta. On brick edifices the gargoyles are of stone, as may be seen on the Jacobins of Toulouse, college S. Remond, and on many other old edifices of the same city.

GAUFFRURE. Gauffer. Stucco Recief.

Application of mortar on stone or wood forming raised ornaments, relief grounds, usually gilded. (Arts. Application; Pe Peinture).

GIRON. Tread. Travel line.

Width of the step of a stairs. The travel line is said to b be straight, when the tread is of equal width for its entire length; triangular, when the step is inclosed in a circular wall. Then the travel is measured at the middle of its length.

GIROUTTE. Weathervane.

A place of iron or copper and fitted with a tube or two rings, rotating about an iron rod placed at the summit of a roof. D During the middle ages not everyone was permitted to place w weathervanes on the roofs of habitations. The weathervane was a mark of nobility, and its form was not optional. "Gentlemen," says Lafourer,[1] have the sole right to have weathervanes on their houses; they are pointed like pennons for simple knights, and square like banners for knights bannerets."-- "It is known," also sasy S. Palaye,[2] "that the first act of possession of a fief or domain, a place taken in war, was indicated by the b banner of the new lord, placed on the most permanent place, on the highest tower." Old weathervanes are rare, they were usually painted with the arms of the lord, or were cut out so as to show the parts of those arms; they were sometimes surmounted by a crown, but that was toward the end of the 15 th c century. Most of the old vanes are so arranged that a solid portion is maintained in equilibrium by counterpoises, so ar to facilitate rotation on the iron axis. (1). The vanes of t the middle ages are small, placed high on iron rods and accompanied by lead terminals. (Art. Epi). The hospital of Beaune still retains the old vanes of its roofs, painted with the a

arms of Nicolas Rollin, chancellor of Burgundy (1441); these vanes are square with a single counterpoise, and decorated at the two corners by cut-out leaves. Here is one of them (2). We also saw in 1833 on the chateau of Amboise vanes from the beginning of the 16 th century with the arms of France perforated and crowned. (3). All French citizens could long since place vanes on their houses, and they did not fail to do so.

Note 1.p.29. Origines des armoires. p. 93. (See Solvoing, Chambolas and la Pebrere.

Note 2.p.29. Memoires sur l'ancienne chevalerie. Vol. I.p. 360. (Notes).

GNOMON. Gnomon. Hand.

A rod fixed in a slab and giving the hour of the day by the shadow cast on the dial. We see in the Olim, that in the 13 th century there were dials on the main roads. Louis IX in 1267 caused an inquiry to be made by a certain knight, Guiters de Vilete, bailiff of Tours, and a canon of Loches, Theobald de Compans, to know if the king had the right to remove stables of horses fixed on the ground and sundials supported by columns, all things that obstruct the roads. We see sundials from the 14 th and 15 th centuries on the angles of certain edifices of the middle ages, notably at the angle of the old tower of the cathedral of Chartres, and at the corner of the cloister of the cathedral of Laon. (Art. Cloitre, Fig. 16).

GOND. Hinge-pin.

Piece of bent iron with flange built into stone, whose cylinder or slightly conical pin enters the eye of a hinge strap of the door. (Art. Serrurierie).

GORGE. Hollow. Overmantle.

A concave moulding. The name was also formerly given to the part of the hood of a fireplace comprised between the lintel and the crowning cornice beneath the ceiling.

GOTHIQUE. (Architecture). (Art. Architecture). Gothic architecture.

GOUSSET. Brace.

A timber placed diagonally to prevent the bending of timbers framed to form a right angle. (1). A is a brace.

GOUT. Taste.

A man of sense said:- "The lack of taste leads to crime." The saying being true in our opinion, we are surrounded by o criminals,or men disposed to become such. Taste is the habit of the beautiful and the good; to be a man of taste, it is t then essential to distinguish good from evil, beauty from ugliness. The good (for deficintions are not wanting, if the quality is rare) is also the respect for the time; we do not admit that one can be an artest of taste without being a man of taste, for taste is not a corporeal advantage, like the s skill of the hand, but a reasoned development of the intellectual faculties. We meet in the world a number of skilful artists, who have no taste in spite of their talent, and some amateurs that are men of taste without having practised the arts. In general among artists,amameurs are regarded as scourges, as usurpers whose influence is pernicious. Not only do we not share that opinion, but we believe that if taste still holds a place in France, it is still chiefly to the public that we owe that advantage. We only claim here to speak of architecture. We cannot admit that an architect obeying restricted interests, mean prejudices, whose character is neither respectable nor respected, can put taste into his works. The man of taste does not lie to his conscience, but he expresses his th thoughts by the most natural means. To have taste in the arts is to love the true, to know how to express it simply. it is to reject exaggeration, always untrue; to allow the moral side of man to appear, with his reason, affections, tendencies and purpose. Then if this moral side is weak, reason be obscure, tendencies are low and the aim is vulgar or odious, it is difficult for taste to be satisfied.

Good taste like truth, is not obtrusive but persuades; and the day when you have said; "Here is the expression of good taste," men will be satisfied by your affirmation, more than that is necessary; it is requisite for this expression of good taste to be discussed and proved by the intimate accord of y your principles with the form that they adopt. If your principles are bad, taste is lacking, however beautiful the form

may be, make the form express the language of the idea, and you will be an artist of taste; yet it is necessary to have good ideas and to express them in good forms.

It has already been thought for a long time, that it sufficed to make proof of taste by adopting certain recognized beautiful types and never departing from them. That method, accepted by the Academy des Beaux Arts in what concerns architecture, has led us to take for the expression of taste certain trite formulas, to exclude variety of invention, and to place outside the law of taste all artists, who seek to express new needs by new forms, or at least subject to new applications.

Since the 17 th century have been placed in honor many hypocrises, and we have the hypocrisy of taste, as we have religious hypocrisy. Those are discoveries that rigorously, we should be beyond. But just like religious hypocrisy, i.e., the external practice of formulas without principles, leading to unbelied and corruption, so the hypocrisy of taste conducts to depravity, and while the Academie des Beaux Arts compels its initiates to submit to formulas, whose sense it does not explain, we see around us it devote itself to the strongest shamelessness, not only outside the sanctuary of the initiated, but within their sanctuary itself. Taste (in architecture) in instead of being a law proceeding from a true and general principle, accepted by all and applicable to all things, has become the privilege of an exclusive school. For example, it has been agreed, that the orders of Roman antiquity were works of taste, which we admit without objection, if those orders have any reason for existence; which we do not admit of nothing justifies their use, Art being reduced to certain practices declared alone to be orthodox in the matter of taste, is atrophied, descending a sted at each generation of initiates; one becomes an architect of taste by following a rut ever narrower and deeper, on the condition of never leaving it. Some architects perhaps find an advantage in that, for nothing is more pleasant and easy in the arts, than to belong to a powerful society; but one can affirm that art has lost by this. With t the Academie des Beaux Arts, the jealous guardian of taste f for a very long time as it asserts, architecture, still so alive at the middle of the 17 th century, has gradually fallen into feebleness, that has led us to gradually fall into anarchy,

to blind obedience or to revolt. But as for taste, good taste, i.e., that exact knowledge of needs, of the genius of our civilization, that true and temperate expression of what it has the right to demand from us, it is necessary to seek long to find it; and if by chance this taste for the true appears, it astonishes the multitude, and arouses censure, if not the wrath of those, who offer themselves as the sole depositaries of sound doctrines.

Every architectural form that cannot be given as the consequence of an idea, a need or necessity, cannot be regarded as a work of taste. If there be taste in the execution of a column, this is not a reason that the colonnade of which it is a part is a work of taste; since for that it is necessary for that colonnade to be in its place, and to have a reason for existence. If it be said; "this palace is badly arranged and inconvenient; the services are not in their palaces, the rooms are dark, the construction is vicious, but it is decorated with taste," that is nearly as if one claims that a book is f full of eerors, the ideas of the author are confused, his subject badly developed, but that it is written with elegance. The first law for a writer is to know what he wishes to say and to make himself understood; clarity is one of the conditions of taste in literature as in architecture. To express his ideas clearly, and elegantly, he must have ideas, and it is necessary for these ideas to precede the form that must s serve to express them. But on the contrary, if we preoccupy ourselves with the form before knowing what it should express, we make no proof of taste. If the porticos of the Romans erected on public places; if those vast monuments accessible to the multitude, permitting circulation of air and light in a fine climate, marked the taste of the masters of the world in urban structures, the colonnade of the Louvre erected above a ground story and inaccessible to the public, sheltering the rare passer through it from neither sun nor rain, and not being in relations to the proportions and dimensions of the other parts of the palace, cannot reasonably pass for a work of taste. If desired, we indeed admit, that the order is studied w with taste, i.e., that it is in harmonious proportions with itself; but that portico is in very bad taste, as a portico applied to a palace. "But this is not the place."

Happily for art, there are times when taste does not need to be defined; by that it even occurs that the art is true, t that it is submissive to the instructions of reason, that it does not repudiate its origin, and only speaks when there is something to say. In those times men are not preoccupied in giving the rules of taste, no more than among upright men they are not occupied in discussing what is lawful and what is not so. Men commence to speak of taste when taste has fled f from art to take refuge in the minds of rare artists; books o on virtue are written only when vice dominates. Those happy times are far from us; they existed among the Greeks of antiquity, they were brilliant during the middle ages, perhaps they might be revived on condition of admitting, that taste consists in the observation of very simple principles, not o in the preference given to some form in preference to another. When taste is restricted within the limits of a coterie, however powerful one wishes to assume it, this is no more than a sad pretension from which all tend to free themselves; for taste, good taste has the privilege of imposing itself in all times and in spite of prejudices, just like anything proceeding from truth. But today men scarcely understand what is taste. Concerning architecture are professed veritable heresies in t the matter of taste; daily are given as models of taste works, whose sense it is impossible to comprehend, that are only notable for complete discord between purpose and appearance. O One says to us that this facade is in good taste; but why? Is it because all its parts are symmetrical; that it is ornamented by columns and statues, that numerous ornaments are scattered everywhere? But the external symmetry conceals very different services; here is a great hall, there a cabinet, farther on is a stairway. This window that lights the chamber of the master is of the same height and form as that opening on a c corridor. Do these projecting columns indicate partition walls, or do they take the place of buttresses? But the division walls are placed beside those columns and on their axes; buttresses are superfluous, since the floors do not rest on this f front wall. We see niches hollowed in the middle of piers, w where we need to find a point of support. If we ridicule persons desiring to appear other than as they are, if we despise a man that seeks to impose on us concerning his rank, his place

in the world, and if we find his manners in very bad taste, why do we find taste in erecting the facade of a palace befo. re offices for clerks, in placing colonnades before walls where not needed, in constructing porticos for promenaders that do not exist, in concealing roofs behind acroterias as an inconvenient thing, in giving to a mayor's offices the appearance of a church, or to a palace of justice the appearance of a Roman temple? Taste is not as some believe it to be, a caprice more or less happy, the result of an instinct, No one is born a man of taste. On the contrary, taste is only the impression left us by a well directed education, the crown of patient labor, the reflection of the atmosphere in which one lives. To know and see only beautiful theory, to be nurtured on and compare them; to arrive by comparison to selection, mistrust judgments ready made, seek to discover the true from the false, flee mediocrity, fear infatuation, these are the means of forming one's taste. Taste is the consideration; it is only acquired after a long time by observation, never exceeding t the limit of the true and just, and never trusting to chance. Like honor, taste never endures any blemish, error, any low concession, no forgetting what is due to others and to one's self. Respect for the public on the part of an artist, who p produces a work, is the mark of taste. Now sincerity is the best mode of expressing respect. If deception was ever permitted, this would be toward those that scorn one. Yet we are far from the rules of taste at this point in the art of architecture, when we show to the public only appearances. We imitate stone with plastering or cement, marble and wood by painting. Those vaults that you believe to be carved stone are only plastering on laths; those oak panels are pine boards covered by coatings of surface decoration; those pilasters of m marble and gold, that appear to support a cornice and sustain a ceiling, are slabs of plaster attached to a wall loaded by their useless weight. Even those ceiling coffers, that represent to us panels in joinery, are nothing but cast mouldings suspended by iron ties from a rough floor, that has no relation to that decoration; so that in that hall in which you believe that you see the workmanship compete with the richness of the materia,, all is deception. Those piers that seem to support are themselves attached like paintings; those arches

conceal wooden or iron lintels; that vault is suspended from a floor that it weakens; those marble columns are cylinders of stucco enclosing posts. The artist is a man of taste, you say; yes, if to make proof of taste is to mock you and to deceive the public in regard to the quality of the work.

Yet how did these artists of the middle ages in France proceed, accused of bad taste by the wits of the 17 th and 18 th centuries, little acquainted with architecture, and by our feeble modern schools, copying in pasteboard and plaster the robust splendors of those latter ages, imitating imitations through weariness and fatigue, for lack of principles and convictions, till the imitation style of the time of Louis XVI, as if the art of this time of weakness had a style? As if to come to that sad extremity it was necessary to send our young architects to Rome and Athens to be inspired by the arts of antiquity?

A first law was sincerity. Had they stone, wood, metal, stucco to be used in the work? They gave to each of these materials the structure, form and decoration suited to them; and even when they had attempted to impose on one of these materials f forms borrowed from the others, taste traced for them the limits that should not be passed, for they never sought to deceive by appearance. One can indeed find that a certain rose w window and certain tracery are delicately wrought; no one would take a rose window in stone or tracery of stone for wood or iron; again these details of religious edifices are merely openings, accessories that do not concern the actual construction, for one would recognize that without being an architect. For them a hall is a hall; a house is a residence; a palace is a palace; a church a church and a castle a castle; it would never have come into their minds to give a municipal edifice the outlines of a church as a pendant, to amuse idlers and g great lovers of symmetry. Did they cover that hall by a tunnel vault of wood? That is indeed a ceiling that we see, not at all the image of a masonry vault. Did they make a ceiling? The construction of the floor gives its compartments and decoration. In their opinion, a roof is made to cover an edifice; so they gave it sufficient inclination to remove the water; they did not conceal it behind an attic; on the same palace they did not erect flat and steep roofs; they adopted either

everywhere according to need, climate or the nature of the c covering. Does a gallery pass behind this wall? We recognize it on the exterior by the manner in which the openings are made; is this a great hall? The windows will be high and wide; is this a row of cells? The windows will be frequent and small. Starting from true principles, simple and reasoned, taste is no longer a matter of chance; it is attached to something real; it brings into the study of details a respect for the truth; it is pleased to express the needs and requirements of the programme; it varies its expression at each instant according to the theme given to it. To know how to say only what is necessary, and to know how to state things properly, is a proof of taste in the relations of the world; it is a mark of taste to give a house of a simple private man, occupied by tenants, the appearance of a palace? "If the owner can pay for this luxury," you say, "why not satisfy him?" Maybe; but you cannot help fi-finding that the architect and his client have bad taste, and the extravagance of the latter does not excuse the compliance of the former. A building ordinance is not written in the style of a discourse at the Academie, an inventory in the style suitable for a romance; and the letter that you address to your gardener to advise him to plant salad herbs at the proper time is not like that you would write to a prince to request his good will. Why then, if we admit these distinctions in the manner of writing, should we not observe them in our architecture? We find in the art of the middle ages that propriety, the mark of an assured taste. The village church does not resemble a cathedral; it is not a diminutive of the latter. The house of a citizen is not built with the appearance of a palace. The city hall cannot be mistaken for a festal hall, or the hospital for a city hall; and the stranger that formerly walked in our cities could divine the purpose of each edifice from its external appearance; it would never occur to him to seek a holy water stoup at the door of a mayor's residence, believing that he entered a church, or to ask at the vestibule of a barrack, the name of the rich lord for whom was erected that majestic edifice.

Taste relates to the object, then first of all it is based on reason. As good sense is one of the (very ancient) qualities of our country, we have brought into our arts a delicate

taste, when we have been left to our own instincts. Unfortunately architecture has long been embroiled with good sense in France and consequently with good taste, under the influence of erroneous doctrines. It was recognized in the 17 th century, that antique architecture was an art subject of pure taste, which is incontestable; men set themselves to produce antique architecture without thinkgin that if antique architecture is conformed to taste, this is because it is the clear a and precise expression of the civilization, that produced it. But if by that even antique architecture submits to the rules of taste under the Roman emperors, it is contrary to those r rules of taste in the society of Louis XIV, which does not exactly resemble the society of Tiberius or Claudius. Then ((in the 17 th century) reasoning scarcely entered into questions of art; architecture was an affair of colonnades, capitals, pediments and cornices, of symmetry, all things declared to be in grand taste, as then said, which without defining f farther what was meant by grand taste, which in our opinion is only a grand infatuation. Yet (for this is an occasion to make proof of taste, and to not fall into exaggeration), it is proper to recognize that this century (we speak of that of Louis XIV) knew how to produce in architecture works of great worth, every time that it did not entirely abandon our French sense. Certainly, one cannot deny that the hospital of the Invalids, for example, is a masterpiece of architecture. Why? Is it because we find there Roman archivolts and cornices? Certainly not; it is because that edifice presents a plan perfectly appropriate to the object; everywhere is grandeur without lost space, convenient services, a general external appearance that clearly indicates its purpose. But to whom do we owe those magnificent arrangements? To Roman antiquity? Did Roman architects give us with other things that beautiful composition of the court with its four stairways at the angles, around which extends the cloister? No, that is the plan of a French abbey c cloister with its vast refectory, its dormitories, its church accessible from all parts of the buildings, its galleries and its daily services. By these arrangements suited to the purpose of the hospital of the Invalids is a work of taste, and n not because the architect has scattered some Roman mouldings on its facades; on the contrary, those details borrowed from

an architecture entirely foreign to our climate, our customs and our genius, only injure a monument, or at least render it cold and monotonous. Those roofs with steep slopes (that are really French) clash with those antique cornices, with those arcades that have the great error of desiring to recall some Roman portico of a theatre or amphitheatre. In that taste cannot be satisfied, for taste demands also a relation, a correlation of the entirety and the details. When Moliere took from Plautus the subject of his Amphytrion, although he adopted t the antique canvas, he has made morning, night, Jupiter, Amphytrion, Alcmene and Sosia, speak like the lords, ladies and servants of the courts, and not like Greeks. Even more, he gave his personages the sentiments, ideas and prejudices of h his time; to express those ideas and sentiments, he has not tacked Greek and Latin words to his French phrases. The names od the personages have nothing to do with the matter, aud Jupiter could call himself Louis the Great and wear a great wig. Certainly Moliere, like all other illustrious authors of the 17 th century, greatly appreciated the ancients, and knew how to use them; did he cease thus to be French, and if we admire him, is not this because he is truly French? Why then in architecture alone is it permitted to one to express himself like a Limousin pupil of Rabelais, and how does that jargon be conformed to the rules of taste?

Stone, wood and iron are the materials with which the architect builds and satisfies the needs of his time; to express his ideas he gives forms to these materials: those forms are not and cannot be due to chance, they are produced by the requirements of construction, by the needs themselves that the architect is bound to satisfy, and by the impression that he desires to make on the public; this is a sort of language for the eyes; why admit that this language does not correspond to the idea, either in entirety or in details? How admit also that a language composed of members without relations to each other can be understood? This confusion introduced in the 17 th century soon made architecture an art unintelligible to t the public; we see today more than ever the sad effects of this.

From the thoughtless introduction of certain forms and not of the spirit of antiquity in architecture, men soon came to the corruption of these forms, whose principles had not been

recognized at first. In the 13 th century men still believed that they employed Roman arts, while they only increased the disorder introduced in the study of architecture. Yet taste and a conventional feeling is so natural with us, that even in that disorder are found traces of that French quality. Our chateaus and public edifices of the last (13 th) century have a certain air of calm grandeur, of reason, very far from the exaggerations found then in similar edifices built in Italy or Germany. One of the most visible signs of the confusion in minds since that epoch is the small part allotted to taste in architecture. Taste has become a matter of detail, of fugitive charm, scarcely appreciable, that cannot be defined and vague, and thenceforth cannot be regarded by us architects as the r result of invariable principles. Taste has been merely a slave of fashion, and it was recognized that artists recognized as possessing taste in 1780 no longer had it in 1800. That depreciation of taste, for example, caused it to be said that such an artist possessed neither the theory nor the practice of h his art; in brief, that he was tolerably ignorant, but that he had taste. Is it then possible to make proof of taste in architecture without being profoundly versed in that art? As proof of the depreciation of taste, we shall cite a serious and enlightened author, and see what he says concerning taste.[1] "Likewise for all that relates to the imitation of the fine arts,[1] the faculty called taste is chiefly credited in agreeable qualities, in the choice of a certain manner of beauty or of working, that feeling alone comprehends, and that no analysis can demonstrate." This is embarrassing, for it says that "no one can dispute about tastes," since he cannot demonstrate whether those exist or not. And further:- "Taste is not that which in composition causes one to discover those ground systems of arrangement, those fortunate lines or imposing masses, that seize on both the mind and the eyes; but it will frequently be what mingles with these combinations the charm of facility, from which results the appearance of spontaneous creation." Thus we see that for one of the most distinguished authors, that wrote on the art of architecture at the beginning of this (19 th) century, taste is indeterminate; it does not preside over the general arrangement, it is called on by the artist only when the work is conceived, and when it is only

necessary to give an attractive turn, i.e., in good French, when necessary to subject it to the requirements of the fashion of the day. It was indeed a trouble to speak or write on taste for two centuries, and found academies designed to maintain the rules of taste, to arrive at this conclusion:- "The charm of facility, the manner of being and doing that feeling alone comprehends!

Note 1.p.38. Quatremere de Quincy. Dictionnaire d'architecture. Art. Gout.

Note 1.p.39. What is this imitationof the fine arts? Does the author desire to speak of imitation or of the imitation of nature in art?

Reducing taste to these pretty and temporary functions, it has been necessary to reduce those, who are regarded as the depositaries of taste. Thus architects soon saw a certain part of public edifices leave their hands, since taste sees nothing in the great systems of arrangement, in imposing masses." Men have thought that their aid was useless, if it concerned the building of bridges, and constructing quays, making great terraces, barracks and military works. And if the public finds most of these buildings ugly, ungraceful and even barbarous, one can say that taste is nothing in them, and that the public is not to seek it there. Well our architects of the middle a ages were in accord with the public of their time, and believed that taste appeared as well in the construction of a bridge or a fortress as in the ornamentation of a chapel or a bedroom; for them taste governed the conception and general arrangement as well as the details of the architecture, and one could even recognize that general quality in the matter was found even during the 17 th century. It suffices to see how were conceived the chateaus of Vaux, Rincy, Beray, Versailles, Monceaux, S. Germain, Chantilly, their parks and dependances, to be assured that taste in the architects, who directed the construction and arrangement of these residences, was not merely a c quality connected with the details, an indispensable manner "that feeling alone comprehends, and that no analysis can demonstrate," but on the contrary the result of good traditions, of knowledge, of general views both just and broad, a result whose causes and effects could be demonstrated. It is rather in the general arrangements, that the architects of the 17 th

century show their taste then in the execution of the details. In fact taste is manifested in all and directs all, in the m midst of civilization in conditions proper for their development. There is as much taste in the composition and order of the Parthenon, in the manner in which it is planted on the A Acropolis of Athens, as in the design and execution of the mouldings and sculptures.

Now see how the architects of the middle ages in France have manifested this essential quality. As we have said above, truth is the first condition of taste. If the architects of that time possessed bricks for building, their construction will n not imitate an edifice of cut stone; they would adopt not only the construction but the decoration furnished by the bricks; avoiding strong projections in belts and cornices; they would not produce the effect by sculpture, but by the masses naturally given by the surfaces of terra cotta covering concrete. Also the brick monuments erected by the architects of the middle ages recall certain Roman structures of the time of the empire; employing the same procedures, they were led to recall the same forms, although then the habits of constructors were very different from those of the Romans. They emphasized the grandeur of those simple masses by lines, delicate but much accented in their details, such as they could compose with bricks set diagonally and corbelled. If they mix stone with bricks, and if stone is scarce, they use it only for monolithic columns, capitals, cornice slabs, sills of windows, jambs and archivolts. The mort costly the material, the more they know how to enhance the value by workmanship. Economic in materials (which is also a proof of taste), they do not lavish them uselessly, but select them according to the function to be fulfilled, the place to be occupied. In the same edifice we shall see monolithic columns, whose transportation, cutting and setting must have required much time, care and trouble, s supporting structures of small materials, raised and set by hand. Faithful observers of the principles of their construction,[1] they desire these principles to be apparent: their jointing is not only a science, but an art that they wish to be appreciated, that is addressed to the eyes, explaining to all the procedures employed without the necessity of being initiated into all the secrets of the practician. Never does the c

construction disguise its means; it does not appear to be other than it is. Thus (and this observation all can make) the edifice of the middle ages gains rather than loses by showing its jointeng, the joints and beds of its structure; can one say as much of edifices built since the 13 th century? On the contrary in most of these monuments, is not the actual construction in such discord with the forms, that one is compelled to seek means suitable to disguise it? For example, can one imagine the colonnade of the Louvre with joints and beds as frankly accented as they are on the facade of Notre Dame of Paris? Then in that one cannot deny to the architects of the middle ages that they are true. One will perhaps object to this; that the Greeks and even the Romans did not accent the jointing, a. a means of construction, the details of the structure, and st still one cannot claim that they have thus lacked taste in ce ceasing to be true. The Greeks and Romans, when they employed stone or marble, had in view the erection of edifices that a appeared all in one piece; they set stones with perfect joints and without mortar between them, so that the joints remained invisible. Among the Greeks the idea of giving to an edifice the appearance of homogeneous material, as would be a monument cut in the rock, was dominant to the point, that if they could not use materials of extreme fineness and purity, when they built in stone and not in marble, they covered that stone with fine stucco, which absolutely concealed those scarcely visible joints and beds. Now we have adopted, or believed that we adopted the forms of the architecture of the Greeks and Romans, and we construct like the architects of the middle a ages, setting stones on mortar or plaster. Then we do not make proof of taste, since our construction is visible in spite of our efforts to disguise it, and that we adopt forms evidently changed if the jointing remains visible. If then in construction to show taste it is necessary to be true, the ancients like the artists of the middle ages were men of taste, and t today we cannot claim the same advantage.

Note 1.p.30. Art. Construction.

Let us pass to the general arrangement. One cannot deny that our churches of the middle ages, large or small, perfectly f fulfil their purpose; that the plans of those edifices, most frequently borrowed from the Roman basilica, but profoundly

modified according to needs and means of construction, were w well conceived, since then nothing better had been found, and that even in the time when the architecture of the middle ages was regarded as a barbaric art, men did nothing but copy these plans and always spoiling them. The beautiful arrangement of the sanctuaries wit side aisles, that belongs to the middle ages, must iufallibly produce a very grand effect. That arrangement is simple, easy to understand, favorable to the development of the ceremonies of worship, and to the most sumptuous decoration. Eveeywhere is easy circulation, air and light. If in the castles of the 13 th, 14 th and 15 th centuries these symmetrical arrangements are not found to be adopted since that time, this is really because the daily needs of the inhabitants of those residences did not lend themselves to s symmetry. Men thought then rather of finding suitable internal arrangements and sufficient means of defense, rather than to present to passers balanced facades. Taste did not then consist in seeking this symmetry without reason, but on the contrary in expressing the various needs by the different appearances given to the buildings. The great hall, chapel, lodgings, kitchen, defenses and barracks, adopted the architectural character suitable for each part. Just as in the city all the edifices were marked at the angle by their purpose, in a castle each service possessed a particular appearance. That did not conform to the taste of architects of the 17 th century, but it did agree with absolute taste, i.e., with truth and r reason. The ancients did not proceed otherwise, and the different parts composing a Roman villa had no symmetrical relation to each other.

The houses of private persons during the middle ages, whether occupying a great area or were small, allowed their internal arrangement to be clearly seen on the exterior. The hall, the room for the reunion of the family, was distinguished from the bedrooms and closets by the arrangement of its openings; stairways were visible and generally projected externally, a and if the stories were mezzanine, the architect did not cut great windows across the floors. The half timber facade was not concealed under stucco imitating stone, and the details were at the scale of the occupants. If the porticos protected passers, they were sufficiently low and deep to shelter them

while leaving an easy passage under their arcades. Before regarding the fountain as the point of view, it was believed t that it was intended to supply water to all that needed it. B Before making the entrance of a public establishment a monumental decoration, it was thought proper to shelter under a hood the persons knocking at the gate. The task of the architect of taste was then to give to everything an appearance suited to its use, free to apply the ornamentation suited to each part. Architecture did not impose itself, it obeyed; but it obeyed like a free person without constraint, without abandoning its principles, placing its resources and its knowledge at the service of the needs to be satisfied, before all regarding these needs as a dominant matter.

To return to methods conformed to taste, we then have something to do, much to undo; we have to lay aside what less indulgent minds regard as the pedantry of the schools, a coterie arrived at the power of a tyrannical oligarchy; we have to re respect the true, and reject the false, to struggle against habits already grown old, and therefore regarded as even respectable, we have also to acquire that facility in the use of the means placed at our command, a facility that is one of th the charms of the architecture of the ancients, like the architecture of the middle ages and of the Renaissance. An amateur of the arts one day said before us, while admiring greatly s some group in terra cotta of Bouchardon:- "It is antiquity without the stiffness." So man roads, as many heresies in t the matter of art. The terra cottas of Bouchardon nowise resemble the antique, and antique sculpture is not stiff. What is rigid, restricted and constrained, is everything imitative, labored and mannered. He that knows, he that is true, makes what he does with grace, flexibility, consequently with taste. In architecture the sole mode of showing taste is to apply p properly the principles that have become familiar to us; it is not to seek imitation of forms, however beautiful they may be, without knowing why we imitate thema

GOUTTIERE. Gargoyle. See Art. Gargouille.

GRANGE. Barn.

A rural building suitable to contain forage and grain. The

monks were greatly occupied in agricultural labors, especially after the 11 th century, and built a great number of barns, either within the enclosure of the abbeys or in the country. An Art. Architecture Monastique we gave some of these buildings surrounded by enclosing walls, just like our farm buildings today. These barns were in very great number and generally well built, for there still exist several of them in Ile-de-France, Normandy, Champagne and Touraine, that date from the 12 th, 13 th and 14 th centuries. Chiefly at the end of the 12 th century, when the abbeys had become very wealthy and d devoted themselves to the cultivation of their lands, were e erected the most beautiful and the largest. Usually they consisted of three aisles separated by two rows of piers or of posts supporting enormous carpentry. M M Verdier and Cattois, in their excellent work on Architecture domestique en moyen age, give several, among others the beautiful monumental barn of t the abbey of Maubuisson, that dates from the first half of the 13 th century. M. de Caumont, in his Bulletin monumental,[1] m mentions those of Perrieres, Ardennes and Eure; they date from the 12 th, 13 th and 14 th centuries. One of the barns of the abbey of Longchamps near Paris still entirely exists; it dates from the 13 th century. We give the plan (1).

Note 1.p.43. Vol. 14, p. 491; Vol. 15, p.183, 443, 493.

The entrance is placed at A in one of the long sides. That entrance consists of a wagon doorway with a house door beside it; at B is a well. Fig. 2 presents one of the gable walls s strengthened by five buttresses, and Fig. 3 is a cross section. The carpentry is executed with the greatest care in fine oak timbers with square corners. Fig. 4 gives one longitudinal b bay.[1] These barns were always placed on sheltered sites, dry and leveled with care, so as to remove rainwater from the base of the walls. In the vicinity of castles, or even sometimes in the court, barns were built to receive the stores of forage and grain required by the garrison.

Note 1.p.44. We owe these drawings, made with the greatest care, to M. Bouloud, architect of the city of Paris.

The great abbeys took care to built their barns on sites surrounded by walls with turrets and well protected gates. These centres of the storage of grain and forage were occupied by monks temporarily detached in these establishments isolated

in the midst of the fields, and because of some fault or to p perform penance. They were also inhabited by converts and by peasants. Thus they contained lodgings placed near the gates, and at night travelers could find lodging in these dependances, indicated by a light and the sound of a bell suspended over one of the entrances. Gradually the abbey barns with th- enclosures and lodgings came to group around themselves the habitations of the peasants, thus becoming the nucleus of a hamlet. We have in France many villages with no other origin, and that have retained the name of the grange. In time of war the peasants shut themselves within the enclosure, and defended themselves at their best. At the instigation of some noble rival of the abbey, they also came to pillage the barns of the monks or to set fire to them, which was no great benefit to t them.

Sometimes these rural buildings contained stables in the g ground story; such is the beautiful barn that yet exists near the church of S. Martin-aux-Bois in the department of Oise. The ground story is vaulted to receive the herds; above is a vast barn for forage. Barns are themselves fortified in certain localities, surrounded by ditches and flanked by towers. yet that arrangement rarely appears till the 15 th century, i i.e., at the time when the country in France was constantly ravaged by bands of wanderers.

GRIFFE. Claw. Corner-leaf.

This name is given to an appendage of the bases of columns during a certain part of the middle ages. One knows that the bases of the Roman Ionic and Corinthian orders consist of annular toruses resting on square plinths. (1). It results from this arrangement tha the toruses A leave four corners A uncovered with a horizontal upper surface, that the least movement of the column would break. We do not deny that the composition of this architectural detail is not perfectly classic, but a after this statement, we may be allowed to regard this arrangement as vicious from the point of view of construction, littl reassuring to the eye, that does not understand why these thin angles are retained under a vertical load. The ancients themselves felt so strongly the practical inconvenience of t the square plinth, that they cut away the bottom bed of these

projecting angles under the diagonals a b (2). That was an a admission of their uselessness; it would have been singular to have not retained them, giving the plinth a circular or polygonal form.

It must be believed that the Romanesque architects desired to avoid a fracture of the angles of the plinth, for from the 11 th century we observe already, that from the last torus to the angle of the plinth was left an appendage or reinforcement, that gives a certain footing of a great resistance to these a angles. These first claws (3) are very simple in form; these are buds or spurs that spring from the torus and rest on the triangular surfaces of the four corners of the plinth (Art. Base). But soon these appendages being very near the eye, of them are made pieces of sculpture, very careful and often very rich. In the 12 th century, in Rhenish edifices are seen bases of cylindrical columns armed with large claws, finely sculptured, that strongly base the toruses on the plinth. Here (4) is one of those claws from the bases of the great piers of the choir of the cathedral of Strasburg. This ornament gives to the base a firmness very suitable for this architectural member, a strength absolutely wanting to the Roman base; the great lower torus is flattened (Art. Base), and further lends itself to receive these appendages.

Around the choir of the abbey church of Vezelay, the great cylindrical piers rest on bases ornamented by very beautiful corner leaves (15). We find some of them very remarkable, likewise sculptured, on the angles of the plinths of the great columns of the sanctuary of the collegiate church of Poissy; some (for these corner leaves vary on each base) representing fanciful animals sculptured with much delicacy (6). These two examples belong to the end of the 12 centurw. At the beginning of the 13 th century, the leaves are less varied in form; but their sculpture is energetic, very appropriate for the place and broadly modeled. Here (7) is one of the leaves from the b bases around the choir of the cathedral of Laon. That leaf is terminated by a crocket scrolled on itself at its end and is intimately connected to the torus; it seems to have started on its surface and to overlay it. One understands that these strong appendages give strength to the corners of the plinth, and permit them to resist the pressure caused by the irregular settlement.

Sometimes (at the beginning of the 13 th century) the leaf is only a recess cut at the angle of a very thick plinth. Examples of this sort of plinth are seen on the engaged columns of the chapels around the choir of the cathedral of Troyes. (8). The most ordinary leaf adopted in that epoch takes the form of a water leaf strongly resembling the heart leaf of a antique architecture, but more strongly modeled. Thus are sculptured the leaves of the bases of the columns of the lower part of the cathedral of Paris (9). About the middle of the 13 th century, the plinths of the bases being almost always c cut octagonal, the leaf disappeared. One sees it reappear in some monuments of the 14 th century, as at the (old) cathedral of Carcassonne (10) and at the cathedral of Sens (11).[1] It de definitely vanished in the 15 th century. One can regret that this beautiful ornament was entirely abandoned; and indeed that if by chance an architect should use it anew as a necessary appendage to reassure the eye, men would not fail to accuse that architect of causing us to return to the barbarous times. But one should not despair of seeing it resume the place, that it so legitimately occupied.

Note 1.p.32. Left pier at the entrance of the nave, restored in the 14 th century.

GRILLAGE. Grille. Iron Grating. Screen.

A network of small iron bars or wire designed to protect g glass from hail, to preserve sculptures from contact, also sometimes precious articles deposited in the treasuries of c churches or castles. There remain few examples of grilles from an early epoch, yet we still possess some dating from the 13 th century. The windows of the chevet of the old cathedral of Beziers retain their gratings, that are pretty pieces of forging. They consist (1) of alternately simple muntins and of muntins to which are welded delicate iron sprays. These gratings are fixed in the jambs of the openings by means of cross bars A; these are provided with swelled openings, as indicated in detail B. The cross-bars are 0.8 in. thick by 1.4 ins. wide; the muntins are 0.6 in thick by 0.8 in. wide; the sprays average 0.4 in square, and are held by means of clamps C set cold. But these are rather very delicate grilles than gratings.

Here (2) is an example of gratings made of iron wire and t

that date from the 14 th century. This fragment was found at Rouen with a dealer in ironwork, and we have seen one absolutely similar in the cathedral of Munich. It will be admitted that those old iron workers or makers of gratings had more i imagination than those of our times. Our modern gratings have a less pleasing appearance.

GRILLE. Grille. Iron Enclosure.

An open enclosure of wrought iron or bronze. Roman antiquity often employed cast bronze for the grilles and enclosures. After the example of the ancients, in the first times of the middle ages, this procedure was sometimes adopted. Every one knows the beautiful grilles in cast copper of Notre Dame of Aix-la-Chapelle, and which date from the epoch of Charlemagne.[1] Those enclosures were apparently made either in the East or by Byzantine artists established in Lombardy. But besides that those enclosures were very dear, both from the cost of the m materials employed and by the cost of modeling and moulding, they could be easily broken. Wrought iron was in very common use in Gaul from a very early period, and was by preference adopted for all open enclosures made in France during the m middle ages. The art of the smith was also developed among us, and it was singularly perfected during the 11 th and 12 th centuries. It is necessary to know that then men did not have the methods of manufacture introduced by modern industry; wrought iron was extended in plates or drawn in the form of bars by hand, without the aid of those powerful cylinders, that now instantaneously reduce a block of red hot iron into iron wire. To obtain a long iron bar of uniform size, well squared and smooth, was a first difficulty of which we have no idea, since all our iron is delivered to us by the mills, rolled i into bars of all dimensions and of very varied sections, without the hand of the smith having ever participated in this p primary work. Although one cannot deny the immense advantages of mechanical fabrication, yet it is certain that smiths have gradually lost the habit id working iron and of knowing its properties. Twenty years ago, one would have vainly sought in Paris a smith capable of fashioning the simplest grille, and if we find them today, this is due to the researches in the industrial arts of the middle ages and to some of those arch-

architects, who as some say, tend to nothing else than to cause the art of architecture to recede toward barbarism. That being said in order to render to each his due, let us occupy ourselves with grilles. It will be understood without difficulty, that when it is necessary to draw out by hand a piece of red hot iron in the form of a bar, men would avoid as much as possible making these bars of great length. The smith is compelled to turn that piece on the anvil and to bring it gradually to the dimensions of a square rod, he cannot exceed certain small dimensions, and he must seek by combinations of t the connections to avoid very long bars, consequently very h heavy. That alone explains why the oldest grilles are composed as far as possible of small bars.

Note 1.p.55. See Gailhabaud, Architecture du Ve au XVIIe siecle

One of the oldest grilles known to us, and that is a work of art, is found in the cathedral of Puy-en-Velay. That hinged grille in one leaf consists of a frame of iron 1.6 ins. by 0.8 in. thick, containing four cross-bars separated by muntins 0.6 by 0.8 ins., between which are arranged iron scrolls very artistically composed. That grille dates, we think, from the beginning of the 12 th century. Here is a fragment of it (1). In height are counted 5 panels of scrolls welded at the connections and held to the muntins by clasps B. These clips are not welded but simply bent hot. Iron forged by hand always p presents irregularities, and the smith to conceal these irregularities had the idea of covering the muntins, scrolls and their clips by strokes of the punch and chisel, which gives this ironwork a bright appearance, costly and refined. The detail (2) indicates this kind op work done cold. Even the i irregularity if the work givas a special charm to those pieces of work on which the hand of man is felt everywhere. The muntins of this grille are set flat and as we have stated, a are 0.6 j 0.8 in. The scrolls average 0.3 j 0.6 in.

Durena the course of the 12 th century the mode of making the grilles was modified little; these are always muntins held in the sash and enclosing ornaments formed of iron spirals or square or flat section. When it is desired to give much strength to the grilles, the muntins and the spiracs present t the edges (3); on the contrany when a light appearance is to be given to them, the muntins and scrolls present their wide

sides (4). This may appear singular, for the geometrical drawing produces precisely the contrary effect; but the architects of the middle ages did not occupy themselves with the purely conventional geometrical effect. It is clear that every grille seen obliquely on the widest part of its surface, if the iron be set edgewise, their broad sides appear and are developed, which gives a striking appearance to the work; on the contrary, if they are set flat, their wide sides diminish by the effect of perspective, and narrow surfaces do not encroach on the vo voids. Fig. 5 gives the same drawing of a grille, that at A b being made with bars set edgewise, the other at B having bars set flat, which will make understood this simple law, generally so little observed, because of the habit that we have acquired of paying no attention to the perspective effect in execution. But a geometrical elevation of a grille A will seem light and the grille B will appear strong, while the contrary occurs in execution.

However about the end of the 12 th century, the smiths sometimes sought combinations other than those produced by scrolls and sprays comprised between the muntins and cross-bars, they connected together with much skill panels of ornaments forming large designs by their combination. But that was rarely employed except for light enclosures composed of very thin bars. M. Didron possesses a very pretty grill of this kind, that has b been engraved in the Annales archaeologiques,[1] and that certainly belongs to the very remarkable ironwork of the end of the 12 th century and beginning of the 13 th. Those grilles are composed of scrolled sprays, only ornamented by some strokes of points or chisels, and seemed too poor to the smiths of the 12 th century, when it was necessary to enclose sanctuaties, to close certain important parts of religious or civil edifices; they soon terminated these scrolls by ornaments stamped hot in the die or matrix of hardened steel. Thus were fabricated the beautiful grilles, some remains of which are still seen in the abbey church of S. Denis, and of which we give a specimen here (6). These grilles date from the end of the 12 th century, are forged with rare perfection, and it s seems that in the hands of the workman the iron acquired the malleability of lead. The ornaments are stamped on only one side. Our Fig. is one-fourth full size, at A we have traced

the section of the spiral at half size. Abbot Suger caused to be made for his church grilles of cast copper, as stated by contemporary authors and by Dom. Doublet, who saw them; they were destroyed at the beginning of the last (18 th) century. One observes that the system of iron grilles composed of panels of ornaments comprsed between the muntins and cross-bars, at the same time offered much stability and lightness; these panels could be easily inserted, removed or repaired, be rich or simple, very leaborate or thin. It occurred that these panels were sometimes grooved into the muntins finished with iron strips exceeding their breadth, thus forming a series of grooves. Many sanctuaries of churches were enclosed by grilles so combined; we still find quite beautiful examples in the choir of the abbey church of S. Germer,[2] and on all sides are remains that show us well, that their use was very frequent, that this sort of works was not at all rare, and that the smiths made them without difficulty. Cupboards containing precious articles, tombs and shrines, were surrounded sometimes by grilles of extreme richness, particularly at the epoch when the art of the smith supplied the most beautiful examples of ironwork, we mean the 13 th century.(Art. Serrurerrie). T Those sorts of grilles are only decorated on the external face, and the scrolls, instead of being placed between muntins and cross-bars, are often placed before the principal framework. For example, such is the beautiful iron grille that protects the tomb of queen Eleanor in the choir of the abbey church of Westminster. We likewise possess in the storerooms of the imperial church of S. Denis, fragments of wrought grilles assembled according to this method (6 bis), that has the advantage of singularly stiffening the simple framework composed of muntins and cross-bars. These scrolls, finely forged, stamped and retouched with the chisel, riveted on the iron framework, gives it great richness at the same time as the stability against e every test.

Note 1.p.59. Vol. X. p.117.

Note 2.p.59. See Encyclopedie d'Architecture. Bonce, editor.

Grilles for protection of treasuries, sanctuaries, rich tombs, preceius reliquaries, not only present an obstacle to t thieves or to indiscreet persons, but they are also sometimes armed with points and spikes that make climbing dangerous; s

such is the grille of the sanctuary of the church of Conques, of which we give a fragment (6 ter). This grille is 4.6 ft. high including the crowning points, and presents externally on each muntin a projecting appendage, that takes away all idea of attempting to scale it; farther the muntins themselves are furnished with points, barbed and forged with care. The appendages A end in little dragons' heads, that seem to be guardians of the sanctuary. This curious grille is described and dr drawn in elevation in Vol. XI of Annales archaeoligiques of M Bidron; i appears to us to belong to the end of the 12 th or the beginning of the 13 th centuries.

Before presenting models of enclosing grilles of a more recent epoch, it is necessary to say some words concerning fixed grilles and gratings fastened in glazed windows, serving both as grilles and for defense. The windows of treasuries of churches, of ground stories, of openings in castles, were often equipped with this sort of grilles artistically wrought. We still see on the exterior of the Romanesque openings of the church of Brede grilles of the 12 th century, interesting to study. Their fabrication is very naive, and yet they produce a very good effect. These Romanesque windows are only 10.2 ins. wide with a height of 3.0 ft. The defense consists of a single vertical bar of iron 1.2 ins. square, cross-bars A passed like keys through enlargements in the vertical bar. These cross-bars are flat, 0.8 × 0.3 in. Scrolls of flat iron 1.2 by 0.2 ins. are crossed and held consequently by means of cross keys A. The vertical stem is diminished at its upper end to enter the hole made in the keystone of the arch, and is made dovetailed at its lower end to furnish a good anchor. Here are no welds, only small forged pieces assembled in the most natural way. We have also seen these sorts of defensive grilles placed before windows of the 13 th century, and which are composed of vertical flat bars 1.4 × 0.3 ins., with keys riveted and crossed as indicated by Fig. 8.[1] The rivet is square in order to prevent the keys from turning. It is necessary to mention here also a very beautiful fixed grille for defense found at Agen, Rue S. Antoine.[2] It now fills an entire round arch 5.2 ft. diameter, and we think it must have filled a rose window. Six panels arranged as voussoirs compose the semicircle, and are held by two semicircles and seven radiating bars.(9).

We give at A the detail of the principal piece of one of these panels formed of scrolls of iron 0.32 in. square welded by means of bands B, according to the method employed by the smiths of the 13 th and 14 th centuries.

Note 1.p.63. Bousscot S. Antonin.

Note 2.p.65. By M Aloux, architect. This grille, or rather fragment of grille, is placed now under an arch of the door of a house, whose erection dates in a quite recent epoch. The c centre of the grille exists no longer, and we assume it to be restored. (Art. Serrurierie).

Let us now return to enclosing grilles with opening parts. Fig. 6 furnishes us with one of the first examples of this s sort of grille with stamped ornaments; but there the bars are stamped and decorated on the flat; the work was much more difficult if necessary to ornamen scrolls set edgewise. Yet that was frequently done by the smiths of the 13 th century. T There is still seen in the church of Braine near Soissons portions of fixed grilles of charming design forged by that method. Very light in appearance and with iron set edgewise, these grilles have great stability. At A is traced the section of the scrolls at full size. These scrolls are stamped on both edges at B and C, which adds much to the difficulty of execution. The thickness of the edge diminishes much at the end of each branch bearing an ornament, so that these ornaments are kept within the thickness E F.

Meanwhile the art of the smith has not remained stationary in France; it sought new means and forms, that had not yet been employed. From the beginning of the 14 th century, the system of grilles composed of scrolls twisted and stamped, assembled by means of clamps and not welded, like the grilles of S. Denis, S. Germer, S. Aventin,[1] of Braine, and of the cathedral of Rheims, were but rarely used; men sought other combinations, introduced plates of wrought iron perforated and in relief, as decorative means, instead of ornaments stamped on solid iron. The smiths desired to produce more effect with simpler means of fabrication. The industry was perfected, but the art lost. Rivets replaced clamps,and even welds; it must no less be recognized, that the workmen of that epoch w were much more skilful than ours, concerning the mode of handling the iron and submitting it to the action of fire. Indeed,

for one that will take the trouble to study the procedures employed by the smiths, what must surprise him in the fabrication of those delicate works, is the uniformity in execution and the malleability of the metal. The iron bars of these old grilles, although placed in the fire a great number of times before the completion of the work, are never burnt, they retain their flexibility, and the welds are made with a perfection and freedom very difficult to obtain today.[1] The file is used to correct the errors of the smith; there a file was never employed on visible parts, but the hammer alone leaves its mark on the iron.

Note 1.p.65. See Guilhabaud, Architecture du Ve au XVIIIe siecle et les arts qui en dependent. Vol. IV.

Note 1.p.68. We do not wish to seem unjust toward our time; with a little persistence and good advice, one again today comes to make these works in iron. Besides, it is never workmen that are wanting in France. The obstacle is routine and prejudices; to speak out, it is the ignorance of the chiefs, an ignorance passed into the state of privilege that cannot be attacked.

Here is a fragment of the enclosing grille of the 14 th century (11), which explains the transition between the system of grilles with stamped ornaments and those obtained with iron p plates in relief attached by rivets. Here are not the attached plates, but there is no longer the stamped iron; the principle of muntins and cross-bars remains, and each scroll is made and introduced in detail A; the cut leaves are obtained at the expense of the scrolls, whose rod has been upset to form a mass and then flattened under the hammer. Instead of b being attached to the muntins by clamps, like the grilles of the 13 th century, these scrolls are riveted laterally at C. The muntins pass through the eyes of the upper cross-bar and are riveted under the lower cross-bar at D; further, they are covered on two faces by two thin bands of wrought iron retouched and incised with the chisel. These strips, that we have o omitted in the drawing of the entire grille, are represented in the detail E; the muntins and cross-bars are 0.6 in. wide by 1.0 in. deep; the scrolls are 0.2 by 0.6 in. deep. The entire grille between cross-bars is nearly 3.3 ft. high.[1]

Note 1.p.69. From a cloister, storerooms of S. Denis.

Generally at the end of the 14 th and beginning of the 15 th centuries, the iron plates serving as ornaments are welded to the large bars or the scrolls; it was only later that the riveted plate was employed as a decoration. There exists in the cloister of the cathedral of Puy-en-Velay a grille of that kind, very skilfully forged. We give it as a whole.(12). Each bay bears an ogee arch welded to the buttresses A.(See at X the section on a b). The apex of the arch is riveted at B to the middle muntin of the bay, which is twisted; the other muntins have a cross section 0.6 in. sqdare. The trefoils C are flattened on the anvil at the extreme ends and cusps. The leaves D and the plate are welded to the arch. Between the m muntins little iron plates are cut and grooved to form the arcade E (see detail G). The crowning leaves are also of plates and are carefully welded to the points of the bars. The bases and capitals of the muntins and the mouldings of the buttresses are shaped with the hammer, without traces of the file. T Then (about the beginning of the 1, th century) men frequenlty set the muntins or cross-bars diagonally, as indicated in the opposite drawing (13). That sometimes allowed the filling ornaments to be held without having recourse to rivets or clamps. Here is a remarkable example that comes from the cathedral of Constance (13). One sees how the diagonla bar A is held by the two notches that fit the two cross-bars B set diagonally. In this example the flat bars of the scrolls are riveted at C to the diagonal bars and are chauged into cut plates at their junction D, these plates all being varied, as indicated by the different sketches H.

In the cloister of the last cathedral is seen a pretty grille of the 15 th century without ornaments of hammered or stamped iron, but whose simple composition and mode of fabrication merit mention (14). At certain distances buttresses A receive cross-bars B, through which pass the muntins C set diagonally. Those muntins are alternately reduced in their upper part, as indicated by detail D, ho receive the scrolls E and their rivets. The other muntins F have tenons, that enter the upper rail through the scrolls at G.

The lower ornamentation presents a similar construction. The scrolls return beside the buttresses as indicated by detail O. On the other hand these scrolls rest against the thin parts

of the points P, to which they are attached by rivets. The muntins F′ pass through these scrolls at R and extend into the h horizontal bar S. One understands that this system of ironwork is very stable; the scrolls are not only attached by rivets, but depend on the principal structure, since the muntins or cross-bars stop them in a sure way by tenons. The muntins are 0.6 in square, the buttresses are 1.2 by 1.0 ins., the cross-bars are 1.2 × 0.8 ins.

The last examples of grilles that we have just given indicate mostly crownings more or less rich. Indeed the grilles of the middle ages always possessed these, unless they were arranged to serve as railings. After the 15 th century, these c crownings sometimes assume great importance, and are merely the decorated prolongations of the muntins passing through t the upper cross-bar. In the bays of the enclosure of the choir in the cathedral of Toulouse are noted fixed grilles, also very simple and fabricated in the 15 th century, whose crownings fill the trefoils of the stone arcade. Here (15) is one of them. The fixed grilles in the windows of castles or of houses are nearly always terminated by crownings, that one can only regard as an expansion of the muntins. We cite here the grilles of the windows of the caslte of Tarascon (15 th century). These grilles are composed of muntins close together and passing through the swelled eyes of the cross-bars, and forming perfect squares with these. The two extreme and central muntins are terminated (16) by cross flowers of welded plates, while the lower ends of the same muntins are drawn out into very sharp points. Each muntin is fixed in the stone by a square bend, as indicated by the profile A. It is the same for the cross-bars. Often the fixed grilles of windows are terminated at top and bottom by very elaborate points presenting formidable defenses; this sort of spiny grilles, a specimen of which we present (17), was placed before the windows of castles, particularly to prevent attempts at treason, the introduction of enemies into a war structure by means of ladders, by openings on the exterior. These gratings deeply anchored with lead at each cross-bar A and even sometimes at each muntin, could be torn away only after long labor. Precautionary measures were ever carried so far, that in certain cases the muntins and c cross-bars were so assembled, that it became impossible, ei-

either to slide the muntins in the eyes of the cross-bars, or the cross-bars in the eyes of the muntins, these eyes being made alternately in the cross-bars and muntins (18). It was necessary to be a very skilful smith to make such grilles, for each eye must be forged as the cross-bars and muntins were assembled, i.e., the grille must be forged while all hot, which must cause considerable labor. Thus the workman must place in the fire each mesh of the grille a certain number of times. But these men seemed to play with difficulties of workmanship, that appear insurmountable to us today. The example here given came from a house in Constance. Grilles of this kind are found, i.e., with alternating eyes, at Troyes, Strasburg, and in many places in the North and East. They date from the 14 th, 15 th and 16 th centuries. This (Fig. 18) is of the beginning of t the 16 th century. However the skill of the smiths is not equal in all the provinces that compose the France of our days.

Iron was wrought much better north of the Loire and in the provinces adjoining the Rhine than in the West and South. Certain grilles belonging to edifices of the 15 th century on the banks of the Garonne, for example, although well designed,cannot be compared to the works in iron of Ile-de-France, Picardy or Flanders.

There is still seen in S. Sernin of Toulouse a grille (19), that encloses the choir at the right of the piers of the transept; although that work in iron may be very well understood in composition, the workmanship is of the coarsest. The muntins of square bars are heavily wrought, and terminate in finials E of hammered and welded iron. Bands of plates A and B are fashioned and perforated, mask the cross-barsof the grille and their swelled eyes as indicated by section D. The plates of the cross-bar b, detailed at B, terminate in little battlements with rosettes, whose form is explained by the perspective figure C. The plates of the cross-bars a b, A B, are held by rivets passing above and below the horizontal bars; they are then entirely independent of the grilles and serve only for the decoration of the work. These grilles date from the end of the 15 th century, and are the first where plates attached by rivets replace the plates of iron hammered and w welded. That simplifies the fabrication and permits the decoration of the ironwork in very rich fashion, but must slightly

depress the school of smiths, so brilliant during a part of the 12 th and the entire course of the 13 th century. Yet this school was not near extinction in the provinces of the northeast, as we have just stated, and the ironwork of the 15 th and 16 th centuries, as forged work on the banks of the Rhine, in Flanders, Switzerland and Bavaria, is perfect in e execution. We do not know who was the smith that wrought the grilles of the tomb of Maximilian at Innsbruck; but as a work in iron, those grilles are superior to all that we know of t the kind. (Art. Serrurierie). At the end of the 15 th and the beginning of the 16 th centuries, one finds very frequently in the provinces of the East grilles, whose panels are made as indicated in Fig. 20. The entire compartment is formed of a single round rod 0.5 in. diameter, bent on itself and penetrating itself, as shown in sketch A. In Art. Serrurerie we describe the procedure of fabricating this sort of grilles, which with great difficulty and after having burnt many iron rods, we have caused to be reproduced by very skilful smiths. Yet this kind of grilles composed of iron rods penetrating in all directions are sufficiently common, that one must admit that they were made without difficulty in the 15 th and 16 th centuries. Although light, they offer perfect stability; for what makes grilles weak today in spite of the unusual weight, that one is obliged to give them, are those tenons and pins, that make of ironwork a fabrication to be compared to joinery. To assemble iron bars by means of tenons and mortises with pins would have seemed an enormity to the smiths of the middle ages and Renaissance; this means, proper in joinery, does not at all accord with the nature of iron, and the dimensions that one must give to the parts of a grille. In fact, we no longer know how to weld iron but assemble it; this is no longer ironwork; and still we believe that we know how to employ the metals suitable for structures much better that did the smiths, who preceded us by several centuries. It is clear that fabrication on a grand scale, that of the mills, has developed in our time in a remarkable manner; but it is also certain that workmanship has fallen much below what it was some centuries since, when it concerns the working of iron. However very beautiful grilles were still made in France during the 16 th, 17 th and 18 th centuries; but hammered and riveted plates play

the chief parts in the decoration of those works; men have l lost the methods of welding so skilfully practised by the guilds of smiths of former times.

GRISAILLE. (Art. Verriere).

GUETTE. Watchman. Sentinel.

The person charged to watch at the tops of the defenses of castles.

"We have no watchman, do you know who watches?" [1]

Note 1. p.79. Goutier d'Aupois. Tale of the 13 th century published by Fr. Michel. 1835.

The watchman was not only charged to warn the persons of t the castle of all that passed in the country, but also to play airs at certain hours of the day:- (old French poem).[1] Sometimes the name of watch is given to the place where the sentinel stands. (Art. Echauguette).

Note 1.p.80. Goutier d'Aupois. Tale of the 13 th century.

GUICHET. Wicket.

A little perforated leaf in the great leaf of a door, that can be opened separately. (Art. Porte).

GYPSERIE. Stucco Work.

A light work in plaster. Plaster was much employed during t the middle ages, particularly to coat interiors. We have also seen in the archbishop's palace of Narbonne a small rose window, whose compartments separate two adjacent halls. The work dated from the 16 th century. A goodnumber of mantles of fireplaces in houses were made of plaster (Art. Cheminee). Thus were made in plaster partitions, open enclosures in the interiors of palaces and ceiling ornaments. (Art. Plancher).

HALLE. Market.

An enclosed area, covered or uncovered, in which merchants by means of a rental paid to the lord of the said place, acquired the right of selling certa n kinds of merchandize. From the 10 and 11 th centuries there was at Paris a market that w was held on a site surrounded by a ditch designated by the n name of Campelli or Champeaux (meadows) nearly on the site of

the market of the Innocents. "At the beginning of the 12 th century," says Sauval,[2] "Louis the Fat established there a new market for the mercers and moneychangers. Philip August in 1181 transferred these to the fair of S. Lazare. Two years l later he caused to be built two markets enclosed by a wall furnished with shops and enclosed by good gates, so that when it rained the merchants could sell their merchandize, and remain covered at all times and in all security." Markets multiplied singularly in Paris during the course of the 13 th and 14 th centuries; S. Louis caused several to be established a about 1263. Generally the markets during the middle ages were nothing but an area belonging to a feudàl lord or to the city, on which was permitted the sale of merchandize. The market was held in a place, under the porches of churches or porticos of houses, around bell-towers, city halls, under sheds. Indeed the market had no monumental character peculiar to it. There is then no reason to enlarge on those establishments. Yet Sauval mentions the wholesale cloth market of Paris, that from 1417, "consisted of 20 bays, was 33.4 ft. wide, and was covered by a vault of cut stone." But that market having been d demolished in 1572, we have no information of its construction.

Note 2.p.80. Sauval. Book IV.

HERSE. Portcullis.

A heavy open frame composed of iron bars or of framed carpentry, sliding in two vertical grooves and forming an obstacle under the opening of a fortified gateway. The portcullis is raised by means of a counterpoise or a windlass; it falls by its own weight. The Romans knew the portcullis; it is seen represented on vignettes of manuscripts of the 9 th and 11 th centuries. Yet in military edifices still standing, we know none earlier than the 12 th century.

We shall have occasion to give a certain number of combinations of portcullises in Art. Porte.

HEURTOIR. Knocker.

A hammer for striking gates. The first knockers seem to have been little mallets suspended on the leaves of portals. (Old French poem).[1]

Note 1.p.81. Li Romans de Berte ous grans pies. Chap. 45. Edit. Techener. 1832.

Iron rings attached to bronze heads outside doors from a very early epoch, also served as knockers, for they often have a ball or enlarged portion, that strikes on a great nail head. Those rings facilitate pulling the leaves, when one desires to close them; further they were a sign of asylum at the doors of certain churches. To demand asylum, it sufficed to seize t the ring. On this subject, Lebeuf [2] says that there was knowledge of that ancient custom (also mentioned by Gregory of T Tours) in the history of the miracles of S. Germain, collected by the monk Heric of Auxerre, under Charles the Bald. In the 16 th century to indicate the action of using the knocker, men said "tabuter" at the door. [3]

Note 2.p.81. Histoire de la ville et du diocese de Paris. Vol. I. p.374.

Note 3.p.81. Symbolum mundi.

Here (1) is one of the oldest ring knockers that we know in France, that is attached to the north door of the cathedral of Puy-en-Velay; it dates from the 11 th century; the bronze head is perfectly preserved; the ring alone has been removed. We give a second one (2), that dates from the beginning of the 13 th century and that is intact; it is attached to the west door of the cathedral of Noyon. Here the head and the ring are of bronze.

But these ring knockers appear to have been especially intended for doors of churches, perhaps because of that tradition of the right of asylum. At the leaves of the doors of houses, the knockers are originally mallets, as we have just stated, then later were hammers suspended by two pins. The most ancient of which we have been able to procure drawings are v very simple in form (3), [1] and are only ornamented by engravings with the graver, that cover the head of the hammer as well as the two eyes holding its pins. Knockers of the 15 th century are less rare; a very beautiful one exists on the leaf of the door of the hospital of Beaune. [2] Here is another that comes from Chateaudun and which is of the same epoch (4). The pins of the hammer are protected from wet by a little shed roof p pierced by a dormer. The whole is of wrought iron of pretty work. One of the most beautiful comes from a house of Troyes (5), and it is now deposited in the archaeological museum of the city. It likewise belongs to the 15 th century, and the

hammer no longer moves on the two pins, but is suspended by an eye through which passes a bolt. Before the stem of the knocker, on a corbel very delicately forged and chiseled, is placed a child holding a shield of arms with vair and charged with a leopard in chief. This little figure is a very remarkable piece of forging. At A is seen the profile of the hammer, half full size. Probably the shield was painted in the colors of the arms.

Note 1.p.83. A knocker that seems to us to be of the 14 th century, and that comes from a door in a house of Vezelay.

Note 2.p.83. See L'Archit. civ. et dom. by MM.Verdier & Cattois. Vol. 8. p.8.

In the 16 th century men returned to knockers in the form of the ring or rapper with a weight at the end, for the doors of mansions and houses. There exist very pretty ones of this kind in the museums of the Louvre and of Cluny. Knockers with hammers were scarcely longer in use except for the doors of r rural habitations.

There were also knockers at the gates of strong castles.-- "Attend the knight that knocks at the gate; and one came out."[1] But it must be admitted, that these knockers could only be attached to postern doors without drawbridges, or to the gates of external barriers.

Note 1.p.85. La Chronicle de Reims (13 th century). Chap. 31. published from the manuscript of the imperial Library by Lewis. Paris. 1837.

Knockers have disappeared from our houses and mansions to give place to bells, which have the advantage of arousing the entire household if some delayed inmate desires the door to be opened in the middle of the night.

HOPITAL. Hospital. (See Art. Hotel-Dieu).

HORLOGE. Clock.

From the 11 th century there were clocks in churches and castles. Those clocks were generally placed in the interior l like great pieces of furniture. That custom was continued until the 16 th century. But bells announced the hours on the exterior. (Old French poem).[1]

Note 1.p.87. Rutebeuf. Du secrestain et de la femme au chevalier. (13 th century).

William Durand in the 13 th century in Chapter I of his work,[2] regards the clock as one of the essential parts of the church. "The clock," says he, "on which one reads and counts the hours, signifies the promptness and care that the priests must h have to say the canonical hours (prayers) at the required times, according to the word:- "Seven times daily have I praised thee, O Lord."

Note 2.p.87. Chap. I, sect. 35.

Abbot Pierre of Chastellux about 1340 gave to the abbey of Cluny a clock, remarkable in that its mechanism presented a perpetual calendar, that indicated the year, month, week, day, hour and minute, and an ecclesiastical calendar that designated the festivals and the offices of each day. That clock further indicated the phases of the moon, the motions of the sun, and then a number of little movable figures representing the mystery of the Resurrection, Death, S. Hugues and S. Odilon, abbots of Cluny, the holy Virgin, the passion, etc. Hours were announced by a cock that flapped his wings and crowed twice; at the same time an angel opened a door and saluted the holy Virgin; the Holy Spirit descended on her head in form of a dove, and the Eternal Father blessed her; a harmonious chime of small bells played an air; fanciful animals moved their wings and eyes; the hour sounded, and all the figures retired into the interior of the clock.[3]

Note 3.p.87. Hist. de l'abbaye de Cluny, by M. P. Lorain. p. 203.

Those complicated clocks were in fashion during the 14 th, 15 th and 16 th centuries. Even on the exterior, the bells of the clocks were nearly always accompanied by "Jacquemars," who struck the bells with hammers. Some bell-towers of our cities of the north, notably that of Compeigne, have preserved those Jacquemars which enjoy great popularity. Everyone has seen or heard of the celebrated clocks of the cathedrals of Lyons and of Strasburg. The first internal clock was commenced in 1312 and finished in 1354, in the episcopate of Jean de Lichtenberg; it consisted of a case in joinery with a great disk of wood, representing in painting the relative indications of the principtal movable festivals. In the middle part was found a dial with hands marking the motions of the sun and moon, the hours and their subdivisions. The top was ornamented by a statuette

of the Virgin, before which at the hour of noon bowed the three magi; the cock crowed at the same instant and flapped his wings. Small chimes played airs at certain hours. That clock was replaced in 1547, then rebuilt in 1838; that is the one which we see today on the wall of the south transept, opposite the place reserved for the old clock.[1]

Note 1.p.88. Desc. abreg. de l'horloge astron. de la cath de Strasbourg. 1847.

There are also seen in the cathedrals of Beauvais and of Rheims clocks, whose cases date from the 14 th century. They have both been very well engraved in the collection published by M. Gailhabaud.[2]

Note 2.p.88. L'Arch. du Ve au XVIIe siecle . Vol. IV.

On the towers of the 12 th and 13 th centuries no place is arranged for placing dials that can be seen afar; this causes the supposition that before the 1, th century, if the bells indicated the hour to the inhabitants of the cities, there were no external dials. These were not seen to appear until about the end of the 15 th century. They are covered by little hoods, made of wood or lead, and covered by paintings.

HOTEL. Mansion.

The name of mansion (hotel) was given to habitations in cities, that belonged to lords or to rich private men, but which did not have the character of the castle, i.e., possessed no feudal rights.

The residence of the sovereign in Paris wal called the p palace. The Louvre was built outside the walls and was a castle. The other residences of sovereigns established in Paris that had no feudal character, were no longer named palaces, but mansions. Men said mansion S. Pol, des Tournelles. Laso mansion of Cluny, Sens, Bourbon, Nevers, Tremoille. At Bourges, the residence of Jacques Coeur was an actual mansion. However, to not confuse the minds of our readers, we have placed the mansions in Art. Maison, the difference between mansion and house being frequently difficult to establish.

HOTEL DE VILLE. City Hall.

House of the commune. The political movement manifested from the 11 th century in a certain number of cities, and that had

as the result of the enfranchisement of the commune, naturally sought to centralize the commune by erecting an edifice s suited to contain the swory officials. Always when the charter of a commune was granted, the right of erecting a house of the commune and a bell tower was included. But until the 14 th century, the communes had to suffer such various changes, authorized today and abolished tomorrow, that there remains very little of the city halls preceding that epoch, the first act of authority that abolished the commune being to require the demolition of the city hall and bell tower. "The histories of the communes," says M. Champollion-Figeac,[1] "sometimes belonged to the king or the sovereign lords, who permitted th their use on certain conditions. In 1271, that of Carcassonne came from a royal gift, and the seneschal exercised there police powers in the name of that monarch.[2] That of the city of Limoges in 1275 belonged to the viscount and his son of that name, who allowed the consuls to assemble there with the provost to discuss municipal affairs, and it bore the name of consula e. Yet it had been erected by the commune; but when it was on a site belonging to the viscount, this was the reason why the property was adjudged to him on his demand."

Note 1.p.89. Droits et usages concernant les travaux de construction, etc. sous la troisieme race [illegible] Paris. 1820.

Note 2.p.89. One will note that the citizens of Carcassonne driven out of the old city after the siege laid by Trincavel, obtained from king S. Louis permission to rebuild their city on the other side of the Aude. (Art. Architecture Militaire).

The precarious state of the communes, the small resources at their disposal for paying all charges imposed on them, must often stop them in their projects for building city halls. Y Yet certain great cities, for example like Bordeaux, possessed edifices built to serve for city halls about the end of the 12 th century.[3] It is certain that the cities of Gaul situated south of the Loire had retained, much better than those of the north, the municipal traditions of the last times of the Roman empire. "It was only there," says M. Aug. Thierry, "that t the freed cities attained the fullness of that republican existence, that was in some sort the ideal to which all communes aspired." So those cities possessed edifices to which one

give the name of hall of the commune, at an epoch when in the North men had neither the leisure nor the material means necessary for their erection. Certain parts of the Capitol of To Toulouse indicate a very early date, and that municipal hall was an actual fortress from the 12 th century.

Note 3.p.89. See Bull. de. com. hist. Feb. 1851. Notice sur l'hotel de ville de Bordeaux, by M. Lamothe.

Note 4.p.89. Lettres sur l'hist.de France. (13 th century).

In the little city of S. Antonin situated in the department of Tarn-et-Garonne, a city formerly important and rich, there still exists the city hall of the middle of the 12 th century, that is certainly one of the most curious civil edifices in France. It served as a the hall in the ground story.

The second and third stories each contained a hall and a ca cabinet. A tower served as bell tower and crowned one side of the facade. Here (1) at A is the plan of the ground story. The space H served for a covered market and communicated with a market M formerly existing there; at P was the passage of a p public street under the bell tower. The stairway for ascending to the upper stories was formerly built at E, but that stairs was destroyed long since and was replaced by a screw stairs at V. The part under the bell tower has suffered some changes to consolidate the piers, which were much altered; but those changes allow the primitive construction to be plainly seen. At B is traced the plan of the second story, reached by the door F opening on the old stairs. This second stairs consists of a hall S and a cabinet H looking out on the public place by a window R, and on a principal street by that at T. The floor of that cabinet is raised several steps above that of the hall. The plan C is that of the third story. The entrance door being formerly pierced at F', from the cabinet N' one ascended to the watch turret of the bell tower by a wooden stairs, or rather a sort of miller's ladder passing through the pointed tunnel vault covering the area a b c d. The principal hall S in the second story is abundantly lighted by a beautiful colonnade, always arranged to be glazed.

We give (2) the elevation of that edofice, whose upper part alone is modern,[1] and (3) is a detail of the windows of the s second story. At A is traced the section of that window with the floor B?.and the arch C of the ground story. At D we have

presented the exterior of a part (one third) of the windows, and at E its internal elevation. Casement sashes shut against the upper and lower wooden cross-bars G. The construction of the entire monument is treated with care, built in very hard s stone of the country; the sculpture is of a refinement and r remarkable purity, all the mouldings being in excellent style and cut in perfection. Dishes of enameled faience are inlaid in the stone and ornament certain parts of the facade.[2] On one of the two piers that divide the opening into three bays is seen a statue of a crowned personage holding a book in the right hand, in the left being a long sceptre terminated by a bird; on the other is a group of Adam and Eve tempted by the serpent. These figures are in high relief and small, are of b beautiful character and sculptured with extreme delicacy of details. Some have wished to see Moses, others Charlemagne, a and still others the king contemporary with the monument. With great difficulty some years since, we were able to discover on the open book parts of a painted inscription.

Note 1.p.91. This edifice was restored under the direction of the Historical Monumen s. The restoration was however limited to the construction of the rear stairs, to the top of the tower, that threatened ruin, and to the renewal of the floors. See Arch. civ. et dom. of MM. Verdier and Cattois.

Note 2.p.91. We have been able to find only fragments of th those faience dishes, that were from 11.8 to 15.7 ins. diam.

We give here the visible traces of that painting on the two pages (4); traces, whose meanging we have been unable to determine. Perhaps some archaeologist will be more fortunate than we. Without giving here our opinion for anything but a new h hypothesis, we may see in that statue Christ as ruler; Christ reigns and Christ commands.

The little columns and capitals of the opening, its enclosure and the windows were colored; on the walls of the halls c covered by plaster, we have been able to prove traces of paintings at two epochs (13 th and 15 th centuries). Behind the portico of the ground story was a place that has always served as a market; formerly one could reach it only by passing under the arches of the ground story.

If we still see in the north of Germany and in Belgium city halls of a pretty early epoch, like those of Lubeck, Aix-la-

Chapelle, built in the 13 th century, those of Brunswick, Dantzig, Munster, Ratisbon, erected during the 14 th and 15 th centuries, we no longer possess in France edifices of that ki kind, except that of S. Antonin, preceding the end of the 15 th century and the beginning of the 16 th. One can still study the city halls of that epoch at Orleans, Compiegne, Saumur, Luxeuil, Beaugency, S. Quentin. The most complete of all and most remarkable is certainly the city hall of Compeigne, engraved with much care in the work of MM. Verdier and Cattois.[1]

Note 1.p.84. Arch. civ. et dom. etc. Vol. 1.

That edifice is composed of a single building with a grand winding stairway in the central part of the front; that stairway is crowned by a very pretty bell tower. In the ground story, the second and third stories, great halls are arranged a at right and left of the central tower. Above the portal a w wide recess was filled by an equestrian statue of Louis XII. Two projecting turrets flank the two angles of the building. One will note that this tradition was again followed in the city hall of Paris, erected during the 16 th century and finished under Henry IV.

Several causes contributed to deprive French cities north of the Loire of buildings intended for municipal meetings. Until the 15 th century, the enfranchisement of the communes, although it had consequences important from a political poin t of view, had been able to establish itself in a permanent manner only with very great difficulty. About the end of the 12 th century the bishops, either to reconquer the diocesan authority, that had been in great part taken from them by the religious establishments, or to find a point of support in their attempts to infringe on the lay feudal power, began the erection of immense cathedral churches at Noyon, Senlis, Sens, Paris, Amiens, Chartres, Troyes, Bourges, Rheims, Soissons, Laon, Cambrai, Arras, Beauvais, Auxerre and Rouen, to the construction of which the urban peoples had brought an enthusiasm the more active, as these edifices then assumed a character civil and religious. The citizens were called by the bishops to a assist in the erection of the monument, with the assurance t that this monument should be open for their assemblies, and long regarded the cathedral as a municipal edifice in those cities dependent or near the royal domain. And we see indeed,

that until the 16 th century, the cathedrals not only served for religious services, but for political and secular assemblies (Art. Cathedrale). That custom being adopted, the urban peoples of the north of France felt less the need of erecting city halls, the more that they knew by experience that those municipal edifices aroused mistrust in the sovereign lords. T The shadow of the cathedral sufficed them. Thus it was only in 1452 that Jean of Burgundy granted the necessary permission to build a city hall at Auxerre. "The inhabitants," says Lebeuf,[1] "had none until then; when it was necessary to treat of their affairs, they were compelled to hold their assemblies in public places or in the churches, in the chapters of communities or in religious cloisters. Also in those places were held the festivals, that served for public diversions." Until the 16 th century, the cathedral of Laon served as the place of assemblage for the inhabitants of the city. Assemblies were held in the 14 th and 15 th centuries in the cathedrals of Auxerre, Paris and of Sens, when it was necessary to deliberate on public affairs. Those edifices retained something of the Roman basilica; markets were installed under their porches, and even beneath their vaults, men trafficked. The bishops naturally aroused themselves against these customs; but it was only very late that they succeeded in destroying them entirely. Consequently one cannot demand from the France of the 12 th, 13 th and 14 th centuries those vast municipal buildings of the cities of Italy and of Flanders; they never existed because they had no reason to exist. But also in those provinces north of the Loire, one sees built under a powerful i impulse the grandest cathedrals ever erected in Christendom at that epoch.

Note 1.p.25. Mem. pour l'hist. civ. et eccles. d'Auxerre. V Vol. III. p. 318.

To form a correct idea of what was precarious in the municipal establishment of Paris, for example, it suffices to read what Sauval wrote on what was the city hall before the middle of the 14 th century. It was only in 1357 that the receiver of the salt tax sold to the provost of the merchants, Etienne Marcel, the house that became definitely the city hall. "As for what that is for a building," adds Sauval, "it was a little building with two gables, and that adjoined several citi-

citizens' houses." That fact alone gives sufficient information, that city halls in France differed little for the most part from the houses of private persons, until the 15 th century. Yet Bourgueville [1] claims that the city of Caen possessed a house of the commune "of very old and admirable construction, four stories high, with flying buttresses founded on p piles in the river, that flowed through three great arches (t (this city hall was built on the bridge S. Pierre); and at p the angles of this edifice and house are four towers connected by battlements, in one of which (the bell tower) is placed a great clock; which house, bridge and river, separate the two sides of the city, so that its four walls commence, end and surround that bridge, formerly called de Darnetal, as found by a certain charter, being in the martyrology or chronicle of the city, of the year 1365." Indeed in the old plans of t the city of Caen, [2] one sees represented on the bridge S. Pierre a building in form of a small castle (for it was necessary to pass under the city hall to cross the Orne), whose eastern f front is opened opposite the great street, that served as a place for fairs. The building is flanked by four turrets and covered by a hip roof; the bell tower was built at the southwest angle. The hall of the assembly was in the second story and had its windows opened toward the river, on the side of the arrival of the ships at the north, and at the south toward the meadows. The situation of this house of the commune was then one of those best chosen for the merchant and industrial city.

Note 1.p.88. Les Recherches et antiquitez de la province de Neustrie, now duchy of Normandy, etc.; by Ch. de Bourgueville, lord of Bros. New edit. Caen. 1833.

Note 2.p.88. Notably that of Merian, and that engraved in f facsimile in the work of Bourgueville. Edit. of 1833.

The arrangement of the houses of the communes from the end of the 13 th century appears to have been nearly the same in the cities of the North from Picardy to Lubeck. A bell tower rose at the centre of the facade and was flanked laterally by two great halls or penetrated the great building with lateral gables. The bell tower served as prison of the commune, for the deposit of the archives, and for a watchman with a c chime of bells. Before the facade opened in the ground story

the portico with grand stairways and a loggia or gallery for public announcements. The city of Lubeck still possesses the remains of a vast city hall, which in the 13 th century was composed of three great adjoining buildings, with three gables on the front and three others on the rear. These gables were pierced by very large windows with tracery, that abundantly lighted those three halls. The ground story was occupied by secondary services. It is unnecessary to recall here that the houses of cities of the North of the 13 th and 14 th centuries presented their gables to the street. This mode was adopted by the city halls, and at S. Quentin also the house of the commune, whose erection was in the 16 th century, retains the principle of that arrangement. By combining the scattered documents that we have been able to procure on the houses of the communes of these three rich and commercial cities of the North, it is possible to present a type of these structures, that more than any other have been subject to so many alterations and catastrophes. Since it would be much too long and wearisome to give separately these scattered documents, we have thought that our readers would not object to our combining them, and presenting a complete type of the city hall of the end of the 13 th century.

That is what we have attempted to do in drawing Fig. 5, which gives at A the plan of the ground story of a municipal edifice, and at B the plan of the second story. Beneath the front portico at right and left rise two stairs and land in the vestibule D, preceded by the loggia E. One enters the ground story beneath the vaults of the vestibule the prisons F of the bell tower, and by the doors G into the halls intended for the daily services. On the second story, from the vestibule D one enters the room I situated under the belfry, and from thence the first hall K serving as vestibule to two great halls L, abundantly lighted by the windows M.

Fig. 6 presents the perspective of this edifice.

But it frequently occurred before the 15 th century, that the bell towers were independent of the city hall. That of Tournay, which dates from the 12 th century, is detached. That of Amiens, whose lower part dates in the 14 th century, was likewise independent of the house of the commune, as well as those of Commines and of Cambrai. Millin, in Vol. 5 of his

Antiquities nationales, gives a view of the city hall of the city of Lille, demolished in 1664, and reproduced frsm a drawing in the library of S. Pierre. According to that drawing the principal building is without a bell tower, and consists of a three story structure with the two great gables and turrets at the angles. The base of the roof has battlements. Behind the building rises a lower structure with battlements s surmounted by lions and by two statues of savager, one of which bears the standard of the city. These structures, so far as the imperfect drawing allows the recognition, appear to b belong to the 13 th century. If many very old bell towers of the cities of the North are detached, that of Bergues S. Winox, which dates frsm the 14 th century, is arranged otherwise, c corresponding to the house of the commune of that city, as do-does that of our Fig. 6. One will note that at Compeigne the bell tower is at the middle of the principal building and on its facade; only it penetrates the great and deep building with two gables placed laterally, yet so as to present in the second story a plan similar to that in Fig. 5.

HOTEL-DIEU. Hospital. Leper Hospital.

Nothing proves that the ancients had houses of refuge for t the sick, where they could receive the care of phnsicians and await their cure. At Athens maimed sildiers were supported at the cost of the republic;[1] but it is not stated tha this aid was anything more than a pension; besides that this fact does not seem to have existed in other cities of Greece. At Sparta, after the battle lost by the Lacedemonians against Antigone, the houses of the citizens were opened to receive the wounded.[2] The Romans in a campaign had places reserved for sick men and horses; but no author mentions, neither at Rome nor in the c cities of the empire, hospitals intended for wounded soldiers or for the sick poor. S. Jerome first speaks of a certain Fabiola, a certain very wealthy Roman lady, who founded about the year 380 a hospital in which were received the sick, previously lying abandoned in the streets and on the public places. In t the first tomes of the middle ages, indeed in the cities of Italy, France and Germany, there were made numerous foundations for the care and shelter of the sick, travelers anf the poor. At the origin thise foundations consisted in bestowing

a house or place with a perpetual income. Naturally the regular religious establishments, chapters and even parishes were guardians of the foundation. "The earliest mention of the hospital Hotel-Dieu of Paris," says M. Guerard in his preface to the cartularies of the church of Notre Dame of Paris, "perhaps was in the year 829." Du Breuil [4] admits that this establishment was founded by S. Landry, 28 th bishop of Paris, about 660. William of Nangis states in the Vie du roi S. Louis, that this prince considerable enlarged it in 1258. Lebeuf [5] claims that this hospital still bore the name of S. Christophe in t the 10 th century; he finds no proofs that S. Landry established near Notre Dame a leper hospital or a hospital. He says, "that one should distinguish between a hospital, Hotel-Dieu, and a leper hospital. I have much difficulty in believing that leper hospitals were originally near the cathedrals, which w were built in the interiors of cities. For natives that could not do without, I confess that they could have been given hospitality in that quarter under the second race of our kings. Perhaps," he adds, "that with more profound researches one w would find the epoch of the change from the hospital or house of hospitality to that cathedral to a leper hospital or Hotel-Dieu." In 1168 under the episcopate of Maurice de Sully, the number of beds was increased because of a statute of the chapter of Notre Dame. It was decided that all the canons that c came to die or resigned their prebends, should give to that hospital a furnished bed. Thirty years after that rule, Adam, cleric of king Philip August, made a gift to the Hotel-Dieu of two houses in Paris, so that from the rent of those houses, on the day of his anniversary, there should be supplied to the sick all that came into their desire to eat."

Note 1.p.100. Plutarch. Life of Solon. Chap. 31.

Note 2.p.100. Justin. Historia. Book 28.

Note 3.p.100. Coll. des doc. ined. sur l'hist. de France. Vol. I. Paris. 1853.

Note 4.p.100. Theat. des antiq. de Paris. 1612. Book I.p.74.

Note 5.Hist.de la ville et du dioc. de paris. Vol.I.p.22.

During the 11 th, 12 th and 13 th centuries, there was founded a prodigious number of hispitals; nearly all abbeys had a hospital within their enclosure. Further, there were founded a great number of leper hospitals outside the cities. "The h

house of S. Lazare, "says Lebeuf,[1] "must not be regarded as a celebrated leper hospital. As much as the city of Paris was famous, so was its leper hospital of its kind. It was in the 12 th century, that men commenced to have more care to separate lepers from the rest of the people; from the epoch of the origin of all those leper hospitals named S. Lazare, whose remains are still seen near an infinity of market towns and villages of the realm. From the reign of Louis the Young, there was between Paris and S. Denis a hospital for lepers, which consisted of a group of several huts in which they were confined. Odon of Dueil, a monk of S. Denis, wrote that he was a witness in the year 1147, on Wednesday, June 11, how this same king, coming to take the standard at S. Denis before starting in the crusade, entered that hospital situated on his route, and took the trouble to visit the lepers in their cells, accompanied by only two persons." This celebrated leper hospital from the end of the 12 th century was governed by t the religious of the order of S. Augustine. Leper hospitals to the number of 2000 were in the states of the king of France in the 13 th century, as proved by a donation made by Louis VIII in his will of the month of June, 1225.[2] We shall not seek to establish here whether leprosy was imported into France by the crusaders returned from Palestine, or if as claimed by some authors, that malady already existed on the soil of western Europe from the Celtic epoch.[3] What is difficult to deny is, that this or a certainly similar disease, either was or was believed contagious, existed over the entire area of Europe in the 12 th century, even in countries that had sent no person to Palestine, since according to Matthew Paris, there were counted no less than 19,000 leper hospitals in France, Germany, England, Italy, Spain, Brabant, Switzerland, Bohemia, Poland, Bavaria and in the states of Denmark. Those establishments were situated outside the cities, as we have just stated, and consisted of an enclosure in which rose cells, very similar to those of the Carthusians with a common chapel. The religious who had the temporal and spiritual care of the leper h hospitals lodged in buildings near the church.

Note 1.p.101. Hist. de la ville et dioc. de Paris. Vol.I, part 2, p. 481.

Note 2.p.101. Latin note.

Note 3.p.101.See the curious work of M. Labourt. Recherches sur l'origine des ladreries, maladreries et leproseries. Paris. 1854.

It is clear that architectural arrangements had nothing to do with those enclosures with scattered huts. It is not the same for the hospitals. There remain to us from the epoch of the middle ages, and particularly from the 12 th and 13 th c centuries, admirable buildings devoted to the sick collected in the monasteries, in the vicinity of cathedrals, or even in flourishing cities. Each monastery possessed its almoners, i. e., persons charged with exercising hospitality. During the middle ages, hospitality was obligatory. From the Carlovingian epoch existed taxes intended to succor the poor, pilgrims and the sick. Chatlemagne in his ordinances and capitularies, had recommended to his subjects to offer hospitality, and"it was not permitted to refuse travelers shelter, fire and water."[1] The communes emulated the kings, the lords and simple private men, in works of benevolence. Many cities established hospitals at their expense, either in new buildings, or in abandoned edifices, that were restored in view of this purpose. Hospitals were even built in isolated places to serve as refuges f for travelers, and to protect them from the thieves that infested the roads; these buildings were often founded by cenobites under the care of the religious. Cities were usually shut at night, and delayed travelers were compelled to pass the n night in the open air; houses of refuge, a sort of free inns, arose not far from the gates." In 1202 two German nobles desired to remedy that serious inconvenience and caused the building of a refuge outside gate S. Denis at Paris. A site containing about [illegible]. A great hall of cut stone erected at the middle of the ground by means of open arches, was built for the poor to sleep there; it was 140 ft. long and 38.4 ft. wide."[2] In 1310 the number of hospitals, infirmabies and leper hospitals that received aid in money from the private purse of the king of France was about 500; in the suburbs of Paris alone, 43 infirmaries benefited by those gifts. Public and private charity also knew how to make its aid more efficient by founding hospitals for particular diseases. S. Louis gave the example by causing the erection of a hospital of the Eighty for the blind of Pa-

Paris; without mentioning the leper hospitals, there were founded in many cities hospitals for the lame, idiots, poor old men, and maternity. The confraternities also desired to have their houses of refuge and hospitals, and finally, during the pestilences that desolated the cities of the middle ages, bishops and lay lords loaned places belonging to their residences for the care of the sick, and frequently themselves also desired to assist them. Beside the disorders of every nature and the numberless abuses that mark that epoch, it must be recognized that all, small and great, sought to mitigate the fate of the suffering classer by the most efficient means, and that the spirit of charity was never more active than in those times. It must be stated, that frequently a certain lord that founded a hospital when dying, during his life had caused more misfortunes than could be relieved in a long time in the house erected by him. The middle ages are so made; they are an unlimited mixture of good and evil; so that there is much injustice in presenting that epoch as a time of continual misery, as an age of living faith, charity and wisdom. Everywhere beside an evil or monstrous abuse will be found the feeling of right, respect for man, for his misfortunes and weakness. The word fraternity is not alone in speech, but everywhere finds practical application, and if passion or interest too frequently infringe that sacred law, at least its principle is never scorneda In fact, our great charitable institutions came to us from the middle ages and survive them; it is well to not forget this too much; having profited by the good part of the heritage, perhaps it would be just to be indulgent to its miserable side.

Note 1.p.102. See Droits et usages, etc. by Champollion-Figeac. p. 182. Paris. 1820.

Note 2.p.102. See the same.

One will understand that among so many edifices erected under the inspiration of living charity, desiring at once to a apply a remedy to the evil, many were merely mud hovels, houses that were assigned good or bad to the service of the poor and sick; for a number of those refuges consisted of a house given by a simple citizen with an income received from his p property. Gradually these modest donations extended and were enriched by collections, becoming important establishments.

Yet there still remain to us some hospitals of the middle ages, that are remarkable from the point of view of art. Well built, well ventilated and spacious, they also have this advantage over the similar ones that we build generally today, of leaving a large place to art, of not depressing the sick by that cold and desolate appearance, which characterizes a public edifice of charity in our time (with rare exceptions).[1]

Note 1.p.103. It is necessary to recognize that recently a great progress has been made in this line. The hospital of Charenton, those of Vincennes and of Vezinet are not only p perfectly appropriate for their purpose; but also as works of architecture, these are made to give the sick ideas rather pleasant than gloomy.

Among the oldest hospitals that still exist in France must be cited that of Chartres, located near the cathedral, and t the hospital of Angers. The latter is particularly remarkable for its extent and by the services that surround it. Here is the plan.(1). It consists of a great hall A with three aisles, preceded by a cloister, an adjacent chapel B, lodgings now u used for other purposes, and a vast storehouse or granary C, suited to store provisions of all kinds. The construction of this establishment dates from 1153. The chapel is a little more modern (1184). Also about the last epoch was erected the great building for provisions. Fig. 2 presents a cross section of the great hall, in which four rows of beds could easily find places. The construction of these buildings is excellent, treated with care, the capitals of the piers being in an excellent style. The building for provisions is an edifice remarkable for its arrangement and details.[1]

Note 1.p.104. See Arch. civ. et dom., by MM Verdier and Cattois, Vol. II.

The hospital of Chartres dates at nearly the same epoch and today consists of a great hall with three aisles, separated by two rows of columns and bearing a ceiled roof. At the rear three stone vaults cover the last bays. This is an arrangement analogous to that of the hospital of Angers, and that appears to have been generally followed during the 12 th and 13 th centuries.

In the abbey buildings of S. Jean-des-Vignes of Soissons and of Ourscamp are still seen beautiful halls that were devoted

to the sick. The hall called that of the dead at Ourscamp is the most beautiful and the best understood of all those hospital structures. This is always a great interior divided in three aisles, that of the middle being wider than the two others; the whole is covered by cross vaults and a vast attic.

Fig. 3. presents the plan of that hall with its annex, that probably served as kitchen and laboratory; Fig. 4 is a transverse section of the great hall for the sick, and Fig. 5 is one of its bays. One will observe that the windows are arranged to give much light in the interior; the upper ones being with fixed glass, while the lower can open to ventilate the hall. According to the arrangement generally adopted at that epoch, it must have four rows of beds arranged as on the plan indicated at A; the hall could easily contain 100. Along the walls between the columns are pierced small recesses at the height of the hand for placing the beverages or dressings for the sick. A great fireplace opening against the gable wall B permits sanitation and warming of this vast interior.[1] The building and its annex are detached. The gable wall G is near the transept of the church, with which it probably communicated by a little passage H. The entire structure dates from the first years of the 13 th century, and the interior was painted with red joints, the archivolts festooned with little arches.

Note 1.p.106. For fuller details, see the engravings of the Archives des monuments historiques, published by order of the minister of State; also the work of MM. Verdier and Cattois previously cited. Vol. II. p. 104.

In Art. Construction, Fig. 123 and following, we have given a building dependent on the abbey of S. Marie de Breteuil, a part which served as the asylum for the poor. Nearly all abbeys thus possessed buildings sufficiently vast to afford an arylum for travelers, or even actual hospitals, like that great hall of Ourscamp.[1]

Note 1.p.107. The abbey of Ourscamp now belongs to M. Peigne-Delacour, who fortunately preserves with particular care those remarkable remains.

The city of Tonnerre possessed already in the 11 th century a hospital situated beside the church Notre Dame, according to custom, and that served as chapel of this establishment; another hospital, also of the same epoch, existed in the sub-

suburb of Bourberault. "The dependances of that hospital," s says M. Camille Dormois,[2] "consisted only of a little dark c chapel, a very small house and a garden." In 1204 Eudes III, duke of Burgundy, founded in the same city the hospital of S. Esprit; but Marguerite of Burgundy, sister-in-law of S. Louis, and queen of Sicily, desired to endow the city of Tonnerre w with a magnificent hospital. In 1293 she purchased a vast enclosure near a spring named Fontenille, along the Armencon a and the walls of the city. In the deed of foundation, it is stated that the poor will be lodged in the establishment, the convalescents be fed for seven days, and sent away with a shirt, coat and shoes; that a chapel is to be built with four altars; that the brothers and sisters to the number of 20, c charged with the care of the interior, shall have as mission to give to eat and drink to those hungry and thirsty, receive pilgrims and entertain them, to clothe the poor, visit the sick, console prisoners and bury the dead; that the brothers and sisters shall have separate dormitories and refectories, and shall only take their meals after serving the sick. The hospital was royally erected, and Marguerite caused to be built beside it a house, so as to be able herself to supervise her establishment; when she died in 1308, the buildings and their dependances had already been long completed. There remain to us the great hall of that hospital and some dependances, and our readers will probably not dislike to have given to t them the entirely and details of the principal part of that g great hall, at the same time a hospital and a chapel.

Note 2.p.107. Notes Hist. sur l'hop. de Tonnerre. Auxerre. 1853.

Fig. 6 presents the plan at the scale of 1 : 100. At A is the great hall, formerly preceded by a porch B with stairs, w whose purpose we shall indicate. That hall contained 40 cells with wooden partitions, a sort of alcoves in each of which w was placed a bed. (See at C). At D was a priucipal altar beneath the vault, and at F were two chapels likewise vaulted. The tomb of the foundress was at E and consisted of a bronze figure lying on a sarcophagus. The sacristy of the chapels w was at G. At H a rood screen was placed before the choir, and connected two lateral galleries, that established a continuous passage above the alcoves, allowing the opening of the windows

and overseeing the interiors of the cells. One could ascend to the galleries by the lateral stairs of the porch [1] and by the stairs I, that was in communication with a gallery connecting the house of the queen with the great hall. From her apartments in the second story of that house, this princess could thus either descend into the hall, or inspect the cells by walking on the gallery that they supported. At Z was a little chapel. The buildings for the service of the hospital are situated at K and the kitchen at M. Communication from these buildings with the hall was by means of another gallery N ending at a little door. The public street passes at O. At P was the cemetery; at J the garden of the queen, bounded by the wall of the city and by the stream of Fontenille. At R the laundry; at V a branch of the Armencon, and at S the priory. Two subterranean sewers passing along two sides of the great hall carried into the river all sewage from the establishment. Besides the walls of the city, ramparts surrounded the other parts of the enclosure. At X was the public well.

Note 1.p.109. The accounts of 1558, according to that excellent work of M. C. Dormois cited above, presents expenses occasioned by rebuilding one of those galleries.

"Paid to Jehan Desmoisons, carpenter, the sum of 81 livres 10 sous for making the great gallery of the said hospital, 1 128 ft. long and 12.8 ft. wide. To Nicolas, mason, for building the masonry to support the posts of the gallery. To Jehan and Pierre Les Mathieux, roofers, the sum of 8 livres 13 sous for covering the stairway of the said gallery. To Jehan, merchant, for ironwork for the doors of the hospital and the rafters of the great gallery, etc.

Fig. 7 gives the transverse section of this magnificent interior, that is no less than 61.0 ft. wide inside by 233.7 ft. long from the porch to the sanctuary. The section (Fig. 7) s shows at A the alcoves with an upper gallery B, passing over the rood screen. One perceives three apses at the back. The carpentry is of oak, well preserved and with timbers of extraordinary length; the tiebeams in one piece are 70.2 ft. long; the principals and trussed rafters are 62.4 ft. It is entirely ceiled with a round tunnel ceiling slightly depressed in the interior. At C we have traced one of the trussed rafters and at D the section of a bay of the carpentry with the ceiling

and the ventilators E with 4 ins. openings. The side windows with tracery are arranged to be opened from the bottom of the springing of the pointed arch, and steps are placed at the s sill permitting one to draw the bolts. This interior exists nearly intact, except the porch, and produces a grand effect. It is one of the most beautiful examples of civil architecture of the end of the 13 th century; nothing less was required than the entire influence of the commission of historical monuments to obtain its preservation from the city of Tonnerre. Why did the city of Tonnerre desire to demolish this edifice? One would probably have much difficulty to learn. Why did the city of Orleans demolish its old hospital, one of the most beautiful edifices of the Renaissance? How many cities without any serious reason have destroyed monuments that proved their age, t that gave them a particular interest, and that retained strangers within their walls? Much regretted a little late were t those acts of vandalism, and men were astonished that travelers passed with indifference through the midst of their new streets, not even giving a glance at the columnar facade of the palace of justice, or the facade of the new hospital, easily mistaken for a barrack.

The arrangement of the beds of the hospital of Tonnerre, each placed in a cell with upper service gallery, merits our careful attention. Each invalid, being subject to the oversight so much easier because exercised from the gallery, found himself in possession of an actual chamber. He benefited by the enormous volume of air contained in the hall, and received light from the lateral windows; his head being placed next the wall and sheltered by the projection of the gallery, he could not be wearied by the brightness of the light. Perhaps one would object that the ventilation of these cells was imperfect; but the hall only containing 40 beds, the lateral windows could be opened, and the interior being very high, ventilated by h holes made in the carpentry ceiling, one can admit that the conditions of sanitation were good.

To show our readers the arrangement of the cells and galleries of supervision, we present (8) a perspective view of one bay of the hall.

The windows of the gallery being filled with grisaille glass, those of the sanctuary had colored glass. A tall spire of car-

carpentry surmounted that sanctuary; it was covered by lead painted and gilded, and was only destroyed in 1793. The entire carpentry of the hall is roofed with glazed tiles and crestings of enameled terra cotta.

By the square stairs built on the north beside one of the two chapels of the chevet, one reached the vaulted hall built over that chapel and formerly serving, as it still does today, for treasury and archives. The tympanum of the principal door opening under the porch next the street was decorated by a relief representing the last judgement, several fragments of w which exist.[1]

Note 1.p.114. To M. Lefort, architect at Sens, we owe minute measurements and drawings of this great hall of the hospital of Tonnerre. M. Lefort had the courtesy to place all his drawings at our disposal.

All those somewhat interested in our old edifices have visited the charming hospital of Beaune, founded in 1443 by Nicolas Rolin, chancellor of the duke of Burgundy. That establishment is nearly as the 15 th century left it to us, although in good part built of wood. It consists of three buildings e erected around a rectangular court. In the building next the street is placed the great hall with its chapel at the end, the porter's lodge and some vaulted rooms intended for provisions. The other two buildings, before which extends a gallery in two stories, contains the novitiate of the sisters, three halls, the kitchen and the pharmacy. Great carpe try gables are glazed and give light in the halls above the external galleries, while the ventilation is made by the same galleries and the opposite sides. (See Arch. civ. et dom. of MM V Verdier and Cattois. Vol. I). The court of this establishment with a pleaseng appearance, well proportioned, still containing its well of the 15 th century, its lavatory and pulpit, almost produces the wish to fall ill at Beaune. The doorway on the street is protected by a hood of carpentry covered by slates. (Art. Auvent).

We give (9) the plan of the hospital of Beaune, and (10) a view of the angle of the court at the principal stairway serving the two stories. At A (see plan) is the entrance; at B a service passage; at C the great ceiled hall[1] with its chapel D, now supported from the hall; at E is the refectory of

the sisters and the parlor of the superior; at F the rooms f for provisions; at G the novitiate of the sisters; at H the halls of the sick; at I a passage opening on a garden; at K the kitchen, and at L the pharmacy; the well is placed at O, the pulpit at M and the laundry at P.

Note 1.p.115. A ceiling of boards has been placed beneath the vault and destroys the grand appearance of the hall.

Let us now examine one of those more modest establishments, far from the great centres, near some abbey or some priory, that were so much scattered over French soil in the middle ages. Let us enter the infirmary called du Tortoir, not far from the road that leads from Laon to la Fere. We shall find there the curious internal arrangements of the hospital of Tonnere. The infirmary of Tortoir, we believe, dates from the first half of the 14 th century.[1] The entirety of the establishment is constructed in a square and still has three buildings of that epoch of construction (11). A is the hall of the sick; B is the chapel; C a building of two stories, probably for the religious and for the kitchen. The other buildings now existing within the enclosure are of quite recent date. Let us occupy ourselves with that hall A. Its two ends are closed by two gable walls with fireplaces. To the court in the interior of the enclosure opens the wide doorway with wicket at the side; on that front are no other openings except two raised windows. Before this wide doorway was suspended a strongly projecting shed roof (if one judges by its traces and the mortises of the carpentry), that served to shelter the carriages bringing the sick. For ordinary use men were contented to use the little door. On the contrary, on the exterior that hall of the sick was pierced by two tiers of wide windows, so arranged that the lower row lighted the wooden cells, similar to those of the hospital of Tonnerre, and the upper series opened on the gallery, to which one ascended by a stairs arranged in bay I (see plan) without a window. At Tonnerre the distance between partitions is 12.3 ft.; the same distance between the axes of buttresses of the hall of Tortoir (see Fig. 12, one angle of the front of the hall on the external side). Assuming the partitions of those cells to be of the same depth as those of the hospital of Tonnerre, and placing seven partitions in the axes of the buttresses, the hall being 32.8 ft. wide, there rem-

remained 19.7 ft., for passage on the entire side and outside the cells (see plan), and one could place seven beds in them, the stairs of the gallery taking the place of one cell. Now t this number of seven beds is very frequently adopted in these little charitable establishments. If we recall that infirmaries were especially reserved for those ill of contagious diseases, and that minute precautions were taken, not only to s separate them from the people, bu also to isolate them from each other, we shall here understand that arrangement of cells with windows, that allowed these poor persons to see the country and to warm themselves in the first rays of the sun, for these windows opened about East. They were further fitted with blinds inside, so as to avoid too great heat. A defensive gallery with machicolations connected the buildings and was in communication with the internal gallery by doors placed in the gable walls. A ditch surrounded the enclosure, as one can recognize by examining the external substructure of the great hall. One reached the tops of the four turrets only by the gallery and by ladders placed in these turrets serving for watchmen.

Note 1.p.112. See Arch. civ. et dom. of MM. Verdier and Cattois. Vol. II. p.107.

The middle ages thus exhibited in the composition of these establishments of benevoleyce the ingenious mind, that one a coords to them in the construction of religious monuments. Indeed it is a singular prejudice to be so willing that those architects should have been so subtile, when it concerned the erection of churches, and at the same time so clumsy when it referred to the building of civil edifices. It was not their fault, that since the 16 th century have been destroyed most of those benevolent establishments infinitely divided, but generally well arranged otherwise, to replace them by hospitals in which on the contrary, men have sought, and perhaps wrongly, to concentrate the greatest possible number of the sick. Louis XIV, the great leveler of all things and all conditions in France, gratified the hospitals erected under his reign by the property of those numerous infirmaries and leper hospitals, that no longer had a reason for existence, since in his time, there were no lepers to be cared for; but this is not to say that the hospitals of the 17 th century were models to pe followed in regard to arrangement, from the point of view of san-

sanitation, hygiene and the respect that should be had for the sick poor. In the few hospitals of the middle ages, that have remained to us, we find a spirit of very extended and delicate charity. Those buildings have a monumental appearance without being rich; the patients have space, air and light; they are often separated from each other, as one may prove in the preceding examples; their individuailty is respected, and certainly if there be anything repugnant to the unfortunate, who find refuge in those establishments, in spite of such enlightened care given them abundantly today, it is the common occupancy of vast halls. Then frequently the sufferings of each patient increase by the sight of the sufferings of his neighbors. Without claiming that the cellular system, frequently applied in the hospitals of the middle ages, was materially preferable to the system adopted in our time, it is certain that from the moral point of view it presented advantages. We adhere to showing that it emanated from a sentiment of very noble charity among the numerous founders and constructors of our hospitals of the middle ages.

Before terminating this Article, we shall attempt to destroy an error widely spread, touching the establishment of leper hospitals. It has been claimed that leprosy was brought from the East to the West at the time of the crusades; but as we have stated above, in the time of Matthew Paris there were 19,000 leper houses in Europe, mostly built in cemeteries having no relation with the East. Further, of 300,000 men led into the East by the brother of Philip I, scarcely 5,000 reached Palestine, and very few returned to Europe. Of the army of the emperor Conrad III, there remained but a small number of crusaders able to see their native land again. Louis the Young and Richard Lionheart returned almost alone from Palestine. Then how could these armies, that were swallowed up in the East, be able to import and distribute leprosy in the W West, so that it was necessary to found 19,000 leper houses to care for lepers? Without entering into a discussion that w would not be in place here, concerning the invasion of that disease in Europe and particularly in France, one may recognize it as certain, that it existed much before the crusades.[1]

Note 1.p.119. On this subject, see Recherches sur l'origine des Ladreries, etc., by L. A. Labourt. Paris. 1854.

Here is the list of the principal hsopitals founded at Paris from the 7 th to the 16 th centuries.

Hotel-Dieu, according to tradition founded by S. Landry (7 th century).

Hospital des Haudriettes, founded under Clovis, and where it is claimed that S. Genevieve died. In the 13 th century t the family of Haudry rebuilt the establishment.

Hospital S. Gervais, founded by Gatier Masson, priest, in 1171. The chapel of that hospital was only destroyed in 1411.

Hospital S. Catherine, originally called S. Opportune (about 1180). The chapel was built in 1222, then repaired in 1479.

Hospital of S. Trinite, Rue S. Denis, founded by two brothess Escuacol in 1202. That hospital possessed a very beautiful hall for the poor to sleep in. In 1210 was added a chapel. The children of the poor were collected and raised in the establishment. The hospital was successively enlarged until 1598.

Hospital of Quinze-Vingts, founded to S. Louis in 1254.

Hospital of S. Marcel (primitively of the Oursine), founded by Marguerite of Provence after the death of S. Louis.

Hospital of Jacobins, founded in 1263. In 1366, Jeanne of Bourbon, wife of Charles V, enlarged it.

Hospital of S. Jacques-du-Haut-Pres, founded by Philip IV in 1286.

Hospital belonging to the priory of the Charite (Notre Dame des Billetes), founded by a citizen of Paris, Roger Flamming, in 1269.

Hospital of S. Jacques-aux-Pelerins, Rue S. Denis, founded 1315 by Louis X. The chapel was completed in 1323.

Hospital of S. Julian-aux-Menetriers, founded by two fiddlers in 1330. In 1334 the founders enlarged that hall by the acquisition of several adjacent houses.

Hospital S. Sepulchre, founded by Philip of Valois in 1333.

Hospital of S. Esprit, founded in 1361 for children.

Hospital monastic or of commandery of Petit-S. Antione, founded in 1368 under Charles V.

Besides these establishments there exist in a great number of communes and in parishes, houses or halls for the sick, the poor and pilgrims.

HOTELLERIE. Hotel. Inn. Tavern.

HOTELLERIE. Hotel. Inn. Tavern.

In the Gallo-Roman epoch there existed on the great roads inns at distances sufficiently small, that the traveler could find a lodging at the end of each day. Those inns or taverns were large hotels in which were found post horses, lodging, food and drink. They served as halts for soldiers, and were placed under the supervision of inspectors, "frumentarii et curiosii," who watched over their being properly kept, and who were charged to spy on travelers. Thus the inns became places useful to the secret police of the prefects of the government, and still to have the right of lodging in the houses, it was necessary to obtain a sort of traveling card. Besides the houses served for lodging not only private individuals and soldiers, but for magistrates and lenders on their rounds, and for the emperor himself, when he traveled. It was in an inn of the country of the Sabines that Titus caught the fever of which he died a few days later. It was necessary to show his traveling card to lodge in the inn, for the stronger reason that he could procure relay horses only with posting letters.

After the invasion of the barbarians, this establishment of imperial inns was entirely ruined, as well understood. The G German races practised hospitality extensively. A Frank or a Burgundian did not believe that he could refuse admission to his house to a stranger; thus in traveling during the first centuries of the middle ages, men were accustomed at each stopping place to ask lodging and food in the habitations found on his route. If the owner addressed was too poor or with too limited quarters to satisfy them, he accompaned them to a neighbor better provided, and all took their repast together. "No other nation," says Tacitus in speaking of the Germans,[1] "receives companions and guests with more generosity; to close his house to anyone whatever would be a crime.[2] According to his fortune, each receives his guest, and offers a repast; and when provisions are exhausted, he that just received him, indicates another refuge and conducts him there; they enter with this new host without invitation, and are received with equal kindness; known or unknown, they are treated with the same regard for the right of hospitality." With the exaggeration in the picture traced by Tacitus, it is however certain that

the barbarous conquerors of Gaul regarded hospitality as a d duty from which one could not free himself.

Note 1.p.121. Germania. Chapter 21.

Note 2.p.121. The riparian law made hospitality an imperative duty, and punished by fine those failing in it. -- The capitularies of Charlemagne command hospitality under the same penalties.

However, from the time of Gregory of Tours there existed inns, since he mentions some of them. The monastic establishments scattered over the soil of Gaulafter the 9 th century exercised hospitality, and in the abbeys or priories of the 11 th a and 12 th centuries is always mentioned the house for guests, built near the entrance gate. There no less existed in the 12 th century a prodigious number of inns on the great roads and in the suburbs of the cities, and those inns, less watched t than in the time of the empire, were the refuges of thieves, assassins, fallen women, gamblers and debauchees. The tale of the prodigal son always represented him at that epoch in the inn, in the midst of women that made him drunk and robbed him of his money. Courtois of Arras is robbed in an inn where all is offered, that can seduce a young man; for the inns were then well furnished, provided with good beds of soft feathers, with good wine in abundance but often adulterated, poultry and venison; girls were attached to the establishment and served as bait to attract, delay and rob travelers.

In the 13 th century inns and taverns were the refuge of the scum of cities, and the ordinances of the kings remained without effect in these dens od scoundrels. Under Philip August in 1192, and during the regency of queen Blanche of Castile in 1229, terrible brawls occurred between the scholars of t the University and the innkeepers of Paris; the provost was imprisoned after the first, and the University dismissed the clerics after the second, on the pretext that justice was not rendered to them. In the 14 th century these disorders only increased; most innkeepers being cutpurses and robbers of passers; so much so that in 1315, to take from innkeepers the d desire to assassinate strangers that stopped with them, an ordinance was issued in which it was stated, "that the host who retained the effects of a stranger dying in his inn, must repay thrice what he had kept."[1] In an inn of Rue S. Antoine at

the sign of the eagle, Jeanne of Divion installed herself to prepare the forgeries by the aid of which Robert of Artois c claimed possession of the inheritance of the countess of Manaut. "That place," says M. Le Roux de Lincy, "was a little inn situated on the bank of the river and beyond the Greve, a part of the city then almost deserted." The taverns then served also as haunts of counterfeiters, as proved by this p passage from Renart contrefait.[2] (Old French poem).

Note 1.p.122. Louviere.

Note 2.p.122. Manuscript of imperial library No. 6985 of L Lancelot. folio 32.

Also in the inns came the fomentors of public disturbances, when they concealed themselves from spies.[3]

Note 3.p.122. See Hotelleries et cabarets au moyen age, by Franc. Michel and Ed. Fournier; Book I. Le livre d'or des metiers.

One will understand that these establishments were nothing but houses, generally isolated, having no distinctive work than a sign hung at the doorway.

HOURD. Wooden defensive Gallery.

A closed structure of planks; applied to military architecture, it is a wooden structure built at the tops of curtains or towers, destined to receive the defenders, overhanging the f foot of the masonry and giving a more extended flanking, a projection very favorable to the defense. We have explained in Art. Architecture Militaire (Figs. 14, 15, 16, 32). the mode of construction and utility of these galleries; they have such great importance in the art of defense of placer frog the 11 th to the 14 th centuries, that we must enter into descriptions.

There is every reason to believe that in the Roman epoch th these galleries were in use, for there is mention in the Commentaries of Cesar, of wooden works that were actual defensive galleries. We have given an example in Art. Fosse, Fig. 1, In the wooden work that crowned the ditches of the camp of Cesar before the Bellovaes, the gallerise connecting the tower s a are continuous galleries protecting a parapet below.[1] The necessity for the defenders to command the foot of the ramparts, to sweep the trenches, and to shelter themselves from the projectiles thrown by the assailants, must have caused the adopt-

adoption of the defensive galleries after the Gallo-Roman epoch. The upper battlements in case of siege could not offer an efficient defense, since in shooting the archers or crossbow men were obliged to show themselves. If the besieger reached even the foot of the walls, it became an entire impossibility for the besieged not only to shoot him but even to see him, without leaning half the body over the battlements. Already a at the end of the 11 th and beginning of the 12 centuries, we note at the summits of towers and ramparts holes of defensive galleries pierced at the level of the permanent galleries.[2] Frequently these holes are doubled, so as to permit placing under the projecting beam a strut intended to relieve its span.

Note 1.p.123. De Bello Bellico. Book VIII. Chapter 9.

Note 2.p.123. For example at the castle of Carcassonne, where the holes of the galleries are everywhere preserved.

The merlons of the towers and curtains of the castle of Carcassonne (about 1100u are high (5.2 × 5.9 ft.); the holes of the galleries are spaced regularly as permitted by the curve of the towers or the internal arrangements; under their piers are pierced four holes entirely through; two a little below t the sill of the battlements and two at the level of the inner gallery. Through the lower hole the carpenters ran a first timber A, then a second timber B, strongly projecting. The workman passed through the battlement and straddled the second t timber B, as indicated in the perspective detail B′, and then entered the strut G in its gains. The head of this strut was fixed to the timber B by a pin; a short post D between the e ends of the timbers stiffened the entire system. Placing planks flat thereon, it was easy to set the double posts E, between which were slid the timbers serving as front protection, and then was placed the roof, which covered the gallery and the inner permanent gallery, so as to shelter the defenders from projectiles shot at random. Holes G made between the front timbers allowed men to aim. Thus the crossbow men posted on the galleries could send bolts through the many slots and drop stones through the machicolations K on the assailants. F From the inner gallery other crossbow men or archers still had the permanent slots L, through which below the galleries they shot arrows against the besiegers. Communication between the inner and outer galleries was established on a level by the

battlements whose merlons were sufficiently high to allow a man to pass. The covering was made of strong planks on which were placed large slates or tiles, and if incendiary projectiles were feared, fresh hides, thick woolen fabrics, manure or turf. This covering was also placed on tops of curtains and towers of all strong places intended to suffer a regular siege, the masonry battlement only serving in time of peace and for ordinary protection. Indeed, the openings were so many doors connecting the outer and inner galleries at a great number of points; and if the gallery was burned or destroyed by stone-throwers of the besieger, there remained standing the masonry protection, offering a last shelter to the soldiers that manned the ramparts.

This sort of galleries was not usually placed permanently, but only in time of war. In time of peace, this carpentry was easily removed and placed under cover in the towers and in the numerous recesses arranged along inside the ramparts. Thus to facilitate setting and to avoid num ering the timbers, classifying and seeking them, the holes of the galleries were pierced at equal distances, except in certain exceptional cases, so that all the protecting planks forming the exterior being cut to lengths slipped anywhere between the double posts set at the ends of the cantilevers. Thus one understands how the placing of the galleries could be rapidly executed. Indeed, the double front posts being set (2), whose section is traced at A, the carpenter only had to slide between them the protecting planks, as seen at B. If stones of great volume, thrown by the machines of the besieger, broke some planks, they could even be promptly replaced from the inside galleries during t the night, without requiring either nails or pins.

Still sometimes the galleries were permanent, particularly at the tops of towers; then the galleries were of masonry like half timber work, or they were covered by slater. There still exists in the castle of Laval a tower of the 12 th century, that has retained an upper gallery, whose construction seems to date back to the 13 th century. This gallery forms a part of the roof and is combined with it (3). It is a beautiful work of carpentry executed in fine and strong oak. According to the custom of that epoch, each rafter is strengthened and trussed, resting on blocks A (see section C), which rest on

the heads of the front posts D receiving a plate S and supported by great double internal braces E. These struts relieve these rafters at about the first third of their length. Under each front post of each strut is placed a timber P, that forms a cantilever and machicolation. At G is seen the front system of the gallery, which is boarded and covered by slates li like the roof itself. At certain distances small openings are pierced in the gallery to allow shooting. The lower radial t timbers are held in place by tiebeams as in all carpentry of conical roofs. We shall return soon to these permanent galleries, very common in military structures of the 15 th century, that are not crowned by machicolations with protecting parapets of cut stone.

During the 13 th century men again simplified the system of wooden galleries at the tops of the ramparts. The double holes were renounced, and they were contented with a single row of large square holes (about 11.8 ins. square) pierced at the l level of the inner galleries; and indeed an oak timber 11.8 ins. square can support an enormous weight, even if it overhangs 9.8 ft. Now the galleries rarely projected over 6.4 ft. It is unnecessary to enlarge here on these simple galleries, whose construction has been sufficiently indicated in Art. Architectura Militaire, Fig. 22. But often in the 13 th century there is a question of double galleries, notably in the Histoire de la croisade contre les Albigeois.[1]

Note 1.p.128. See Coll. des docum. ined. sur l'hist. de France. I series, etc. Translated by M.C.Furiel. 1837.

At Toulouse, besieged by simon de Montfort, the inhabitants constantly increased the defenses of the city. (Old French poem.)[2]

Note 2.p.128. Verse 8854 et seq.

Then at the siege of Beaucaire. (Old French poem).[3]

Note 3.p.128. Verse 3988 et seq.

We have been compelled to seek on the monuments themselves the traces of those galleries in two stories. Now at the city of Carcassonne at both sides of gate Narbonne, whose construction dates back to the reign of Philip the Bold, we have been able to recognize the arrangement of one of these double galleries, indicated by the construction of very strong merlons cut with a batter next the inner gallery as indicated by section A. Their base is pierced at the level of the inner galle-

gallery by holes 11.8 ins. square and regularly spaced for the gallery. On the surface of the inner gallery of the city is a continuous recess B. The double galleries were then arranged thus; every 5 ft. there passed through the holes for the galleries a strong beam C, on the outer end of which stood the inclined post D with a duplex post E forming the slot for passage of the protecting planks. Double timbers J held these posts, rested on the plate E, gripped the three posts G, H, I, G resting on the inclined surface of the merlon, and came to hold the inclined rear post K. A second row of ties placed at L at 5.9 ft. from the first row formed the tiebeams of the p principals M of the roof. At N a slot was left along the external surface of the curtain. This machicolation was served by men placed at O in the inner gallery at each space fitted with an opening P. The archers and crossbow men of the lower gallery were posted at R, and did not have to attend to serving this first machicolation. The second gallery had a machicolation at S. The store of projectiles was made within the c city by a hoist T. Stairs Q were placed at certain distances and connected the two galleries. In that manner it was possible to pile a considerable quantity of stones at V without o obstructing passage in the permanent galleries or the crossbow men. At X one sees the external elevation of the carpentry of the gallery without its protecting planks, and at Y that carpentry is covered. Through the slots of the machicolations could be cast on the assailants a prodigious number of projectiles. As always, the permanent slots U pierced in the merlons opened under the gallery, and permitted a second row of crossbow men posted between the trusses on the permanent gallery to aim at the enemy. One conceives that the inclination of t the protecting planks was very favorable to the shooting. It further allowed making a second machicolation S overhanging the lower gallery. The expense required by such considerable carpentry scarcely permitted it to be established only in exceptional circumstances, at points poorly defended by nature, and that was precisely the case at both sides of gate Narbonne, particularly for the north curtain (Art. Porte), on the extent between that gate and the tower du Tresau to which this system was applied.

If curtains were equipped with galleries, for a still stron-

stronger reason the tops of the towers should be furnished w with that necessary defense, since there was more advantage in attacking a tower than a curtain; so the towers of the city of Caracossonne are all pierced at the level of their upper floors by very wide openings on galleries, well arranged and distributed around the circumference. But these towers being covered by carpentry, it was indispensable to arrange them so that one could put on the roofs of the galleries without injuring those of the towers. For that purpose was left above the cornice a vacant space between the blocks to insert the rafters of the gallery (5), that were laid on the plate of the roof and fastened behind the framing by keys, as indicated by the section A. The gallery of the round tower then formed a polygonal plan with more or less sides, according as the circumference of the tower was larger or smaller, for the openings of the gallery, like the battlements and slots, are always pierced at equal distances. The continuous machicolations were opened along the surface of the tower, at B along the protecting planks, at C according to the locality and occasion, and because why?; the bases of the towers (like those of the curtains) were built battering with rare exceptions. The batter usually ended at the level of the counterscarp of the ditch. If the assailant succeeded in filling the ditch, he reached the top of the batter at G, as indicated by the sketch M. Then the machicolations pierced at C did not strike vertically the miners at G; it was then necessary to have a machicolation at B along the surface of the tower. On the contrary, if a miner attacked the base of the tower at F in the bottom of the ditch, it was necessary to open a machicolation at C directly over him, for the probectiles falling from the machicolation B bounced on the slop and must describe a parabola a b ower the heads of the miners. But if the assailants appeared in mass at the base of a tower or curtain, protected by a rolling shed or cat, the projectile falling vertically from the machicolation B c caused more damage by bouncing, for it could thus enter beneath the cat. At P we give a perspective view of the top of the tower at the end of the 13 th century, forming a part of the walls of the city of Carcassonne, with its galleries placed and partly covered by fresh hides, so as to avoid the effect of the incendiary projectiles on all projecting parts of the

gallery.

But from the first half of the 13 th century, men had already sought to prepare, at least in part, for the danger of fire presented by those projecting galleries placed on cantilever beams, and against which the assailants cast a number of little kegs of Greek fire, and darts wrapped with tow, resin or burning bitumen, all materials that by their nature could stick to the carpentry, and produce a very lively fire, that water could not extinguish. We already see at the tops of the towers erected at Coucy by Enguerrand III from 1220 to 1230 stone corbels, intended for placing the wooden galleries. The combination of these galleries is very apparent and very ingenious at the top of the keep of Coucy (Art. Donjon, Fig. 39). The bottom of the galleries of that celebrated keep, the largest of all those in Europe, is 131.2 ft. above the counterscarp of the ditch. And although at that height the besieged did not have to fear incendiary projectiles, they established around the entire exterior of the enormous cylinder 48 stone corbels projecting 3.2 ft. and 1.0 ft. thick, to receive the gallery whose section is given at A in Fig. 6. At B is seen one of the corbels, each composed of two courses. On these corbels in time of war rested a sill C receiving two inclined posts D, E, Doubled beams F were placed a little above the level of the opening in the battlements, and served to bear a floor intended for crossbow men. Before this floor was opened a machicolation G vertically over the base of the batter of the keep at the bottom of the ditch. According to the system before explained, protecting planks were placed in the slot between t the posts P, doubled by a post held at its base by the horizontal timbers. At the top of the cornice H is built a double slope of stone on which rest both series of rafters H', whose slipping was prevented by the angle at J. On the continuous i internal corbel K being set other inclined posts L, held by double timbers M and tenoned into the rafters I'. On the beams M, timbers receive the floor O, which at each opening rests on the wall, but so as to leave between this floor and that of the gallery the machicolation N vertically over the outside of the tower. The floor O is placed in communication with the terrace by some stairs P, and allows one to reach the floor of the gallery, and to post a second row of crossbow men, who

can shoot through the slots in the masonry. (See the internal face T, which represents at T′ the plain battlements and at T″ the battlements wit galleries). The angle of fire is particularly arranged to cover with projectiles the defensive gallery of the curtain of the keep. The machicolations amply suffice to reach the bottom of the paved ditch, excavated between the curtain and the tower. The defenders may be posted on the gallery or in the interior, being thus perfectly covered. Stones piled in the embrasures of the batteries on the floor O can be pushed off with the foot, and be rapidly dropped through the machicolation N. At S are pierced the ducts c casting outside the water from the terrace; these ducts were formerly lined with lead, like the terrace itself. A fragment of the plan of the top of the keep of Coucy with the galleries assumed to be cut off at the level a b (7) completes the explanation of Fig. 6.

We have endeavored to render an account of the manner of setting these galleries at the height of 151 ft. above the bottom of the ditch, on isolated corbels below the battlements. H Having to place a scaffold at the height of these corbels, to place two iron circles and to repair the crown deeply cracked by the explosion in 1652, we naturally had to seek for the practical means employed in the 13 th century to assemble the galleries. Now all is foreseen and calculated in this remarkable crown of the keep to facilitate that labor apparently so dangerous, and we have been led by the arrangement of the masonry itself, the solids and voids, to apply the procedures employed by the carpenters of the 13 th century, by the reason that they could not use others. One recalls (Art. Donjon; Figs. 33, 39) how is drawn the platform of the keep of Coucy. That platform consists of a wide inner defensive gallery encircling a vault with 12 sides covered with lead and forming a hip roof, at the centre of which is pierced a round opening. This internal gallery, divided in slopes and counter slopes to throw the rainwater outside, could be easily leveled by means of beams laid on blocks. These timbers (Fig. 8) in two rows A and B formed two wooden rails on which was set a crane with wheels A, larger than those at B, allowing it to move in a circle. The end C of that crane passed beyond the outside vertical of the great cornice D. Since on the ridge of that cor-

cornice rose four pinnacles P, it was necessary for the beam of the crane to be raised to pass over these pinnacles. That beam then swung on a pin G, and was brought back to its inclination and fixed at the rear end by the beam F and a bolt I. Detail K presents that crane in elevation on the windlass side. But it was necessary that the carpenters on the exterior could assemble the timbers supported by that crane and taken through the openings of the battlements. An overhanging scaffold is indicated in section at L and in elevation at L′, allowing the first stage M before each opening and at the level of the gallery, and a second stage N below, so as to be able to set the blocks on the corbels and to assemble the inclined posts in these blocks. Workman straddling the top of the ridge of the cornice could easily assemble the rafters together and arrange the plane of each truss. Thus inside the keep the entire operation of placing the gallery could be done in brief time and without requiring scaffolds other than those little overhanging stages placed outside each opening, no other machines than that crane, moving in a circle by means of its wheels of different diameters. The cantilever stage I was only b built for on opening and was successively transferred by the crane itself.[1] On examining this Fig. with care, one sees:- 1, that the openings of the battlements correspond to the distances of the corbels, so that the double timbers O can just p pass along their surfaces; 2, that the arches of these openings are pointed so that the two overhanging beams can be properly set on the wall V; 3, that by means of the two girts R,R, inclined struts S and J, the overhanging beams M could neither move nor fall outward; 4, that the slopes of the great cornice, whose utility could not be explained, had a perfect motive in the inclination of the rafters, that freely rested on their surfaces; 5, that the strong internal and external projection of this cornice by so much relieved these rafters; finally t that what was irregular at first sight in that colossal crowning, nowise motived by the presence of the battlements and s slots, is explained at the moment when one studies the combination of the galleries and the mode of settiug them. But such is that architecture of the middle ages; it is necessary to seek constantly the explanation of all its forms, for especially in military edifices they necessarily have a reason of ex-

existence and utility; and that contributes to the impressive effect of those vast structures.

Note 1.p.136. This procedure was employed by us in the restoration without having to lament the smallest accident. Three workmen were killed during the repairing of the cracks, but because of negligence in the work. Further, this misfortune occurred outside the stages mentioned, and on which were piled heavy stones, iron bars and timbers of considerable weight.

Fig. 9 gives in perspective the methods of the carpenters p placing the galleries of the keep of Coucy. They commenced by the little overhanging stages at the openings, perfectly sufficing to assemble this carpentry, truss by truss; for those being set a passage was thereby established to the outside to spike the planks of the gallery and the timbers of the roof. It certainly must be admitted that the carpenters of that epoch were very skilful in raising, and it further suffices to convince one's self of this, to see the carpentry erected by them; but the practical means employed here are so well explained by the arrangement of the places, and those means are so safe with little danger, compared with what we see daily, that the building of the gallery of the keep of Coucy could present no serious difficulty.[1]

Note 1.p.137. We repeat this; the absolutely similar operation by the same means was executed in very little time with light timbers by four carpenters, directed by M. La France, an old skilful journeyman; these are not hypotheses.

There were no less necessary in order to provide a fortification with its galleries, workmen, timber in abundance, and still one risked the burning of those external galleries by the enemy; hence about the beginning of the 14 th century the carpentry galleries were generally renounced in France, to r replace them by machicolations with a protecting wall of stone. (Arts. Architecture Militaire, Figs. 33, 34, 36, 37, 38; Machicoulis). Only in the provinces of the East did military architects continue to employ galleries. There are yet seen a great number of them in Switzerland and Germany, that date from the 14 th, 15 th and 16 th centuries; but those galleries are usually placed on the tops of walls, and are no longer combined with the battlementr like those of the 12 th and 13 th centuries.

For example, here is a gallery placed on the summit of a tower of the 12 th century at Dugny near Verdun. It is well understood that this gallery is of a later date (10), we think of the 14 th century. It consists of half timber work corbelled out on beams and covered by vertical planks spiked on the top of lower girts of the frame. The whole is covered by a r roof.[2] Many towers in the suburbs of Verdun are still equipped with these galleries built during the wars of the 14 th and 15 th centuries, and which have been since left in place, and serve as belfries.

Note 2.p.137. The drawing of this tower was communicated to us by M. Pettiot-Bellovene of Verdun.

At Constance in Switzerland is still seen a certain number of towers equipped with galleries, that date from the 15 th century. The custom house of that city dates from 1393, and h has retained on its upper part a beautiful gallery of the same epoch, and which we present in section (11). These galleries combine with the carpentry of the roof and crown the tops of the wall at two sides of the building facing the quay. (A (Art. Breteche, Fig. 3). The sketch A shows a system of enclosure by vertical planks on the exterior, and sketch B is the detail of the lower cutting of these fir planks of considerable thickness with their battens C. As always, a continuous m machicolation is left at D.

Men still built galleries to resist artillery; but then took the precaution to replace the planks by masonry galleries between the members. Galleries of this sort still exist in Lorraine and Switzerland, notably on the tower that terminates the bridge of Constance at the city end. At Nuremberg still e exist galleries of the 16 th century on the ramparts built by Albert Durer (Art. Crenau, Fig. 18). Those galleries are o of masonry between the members and crown the parapets of the curtains above the great artillery.

The name of gallery is also given to scaffolds built in halls, either on one of the free sides to allow persons of distinction to see certain ceremonies, ballets or combats in the enclosed space. Those galleries were then curtained, i.e., covered by rich tapestries, shields of arms, paintings on linen and t tapestries. Their interiors were arranged in steps and sometimes divided into boxes by cloth partitions. The manuscripts

of the 15 th century have preserved to us a great number of t those decorated scaffolds, erected on the occasion of a tourney, banquet or festival.

HOURDAGE. A series of galleries.

HOURDIS. Masonry of brick or plaster between the members of half timber work.

HUIS. An old word employed to designate the leaf of a door; the entire opening part of isolated joinery. (Arts. Porte, Vantail).

HUISSERIE. A part of isolated joinery forming a partition or barrier.

IMAGERIE. Sculpture. Carving.
This word was applied in the middle ages to every representation of scenes carved on stone or wood. Sculptors of figures had the name of image-makers after the 13 th century. (Art. Statuaire).

IMBRICATION. Coarse Mosaic.
Employed today to designate a delicate jointing of surfaces, forming designs varied in the arrangement of small cut stones or of bricks. Mosaics are sometimes composed of stones of different colors as in Auvergne and certain provinces of the South; stoves of terra cotta as in the cloister of the cathedral of Puy; bricks of various colors or glazed. Mosaics obtained by means of stones set so as to decorate surfaces are common during the 11 th and 12 th centuries. They are very rarely fo found in edifices of the 13 th century. The coarse mosaics m made of bricks of varied colors are especially found in houses and castles of the 15 th and 16 th centuries.(Art. Appareil).

INCRUSTATION. Inlay.
This word in the architecture of the middle ages in France can only be applied to fillings of lead or cement in sinkings in hard stone, as for example, in pavements, tombstones (Art. Dallage). In France this sort of inlay, so common in Italy, h

has not been employed, and that consists in inserting cut pieces of colored marble in recesses sunk in slabs of white marble. Inlays of this kind are seen in the little church of S. Miniato near Florence, made to ornament the pavement, and enclosure of the ambos of the sanctuary, and even the facade (13 th century). The cathedral of Siena, that of Florence (S. Marie des Fleurs), that of Genoa, are externally covered by marble inlays.

INTRADOS. Intrados.

The internal surface of an arch or vault. (Art. Extrados).

JAMBAGE. Jambs.

Name given to the two vertical sides of an opening, door or window, when that opening is terminated by a lintel. When the opening is terminated by an arch, by preference is given to t the two sides that support the arch the name of "pied droits." (jambs). A A (1) are the jambs of the opening B.(Art. Porte).

JAMBETTE. Strut. Furring.

A carpentry term and usually designates a slightly inclined small timber that relieves the foot of the principal of a truss or rafter and is tenoned into the tiebeam or block. A (1) is a strut. (Art. Charpente).

JARDIN. Garden.

In market towns and even the cities (principally those of the provinces of the North), many houses possessed gardens. Gardens are mentioned in a great number of documents of the 12 th and 13 th centuries; and frequently behind those houses, whose facades look on narrow and muddy streets are little gardens.

Love of gardens and of flowers has always been very strong among the peoples of the north of France, and the tales and romances are full of descriptions of those private walks. For castles the garden was a necessary annex; it always consisted of a lawn of turf with a fountain, when that was possible, ar-arbors and vines, beds of flowers, chiefly of roses, much prized in the middle ages, an orchard and kitchen garden. If one could have some area of water, swans and fishes were placed in it. Peacocks animated the lawns and aviaries were one of

resorts of ladies. The stewards of Charlemagne must feed peacocks on the domains;[2] a list of plants for ornamenting gardens is even given at length.[3] There are found lilies, roses and a quantity of culinary plants; apple, plum, chestnut, service, medlar, pear, peach, hazel, almond, mulberry, laurel, pine, fig, walnut and cherry trees.

Note 1.p.143. De ornatu mundi, poem of Hildebert.

Note 2.p.143. Capitularia, edit. of Baluze. Vol. I.chap.337.

Note 3.p.143. Chapters 341, 342.

In the Parisian Manager [4] are mentioned all culinary and ornamental plants, that should be cultivated in gardens. Therein are found beans, marjoram, violet, sage, lavender, mint, parsnip, sorrel, leek, vine, cabbage, spinach, rasberry, houseleek, fennel, basil, lettuce, pumpkin, borage, cauliflower, broccoli, hyssop, peony, lily, rose, currant, pea, cherry, or prune, etc. The author does not content himself by giving a simple list of names, but he indicates the mode of planting, sowing, cultivating, smoking and grafting those plants; the methods employed for destroying ants, caterpillars, to preserve fruits, vegetables and even flowers in winter. In the country the gardens were enclosed by hedges or palings, sometimes by walls; in the 15 th century the alleys were already bordered by box. The plans of these gardens much resembled those plans that we see reproduced in the works of Du Cerceau,[5] i.e., they were only composed of flower beds separated by alleys and of great rectangular lawns enclosed by trees and trellises affording shade.

Note 4.p.143. Composed about 1393 by a citizen of Paris. Published by the Society of Bibliophiles francois. Vol. II, pa 43 et seq.

Note 5.p.143. Des plus excellens bastimens de France.

The abbeys possessed magnificent gardens with orchards, which were frequently for those religious establishments a source of considerable produce. The monks caused the execution of important works to bring water and to distribute it by means of little channels of masonry or of wood. One monastery was famous for its apples or pears, another for its grapes or prunes; and it is well understood, the religious did everything to preserve the reputation that increased their wealth.

JESSE, ARBRE DE. Tree of Jesse.

Genealogy of Christ. In the gospel of S. Matthew it is said, that Jesse was the ancestor of David the king, and that from this king to Jesus Christ was 28 generations. Now in many of our religious monuments the genealogy of Christ is represented as commencing with Jesse, from whom grows the trunk of a t tree bearing a certain number of kings, then S. Joseph, the Holy Virgin and Christ. This motive of sculpture and painting furnished sculptors and particularly glass-painters with one of their favorite subjects after the end of the 12 th century. Many of our cathedrals placed under the name of the Holy Virgin present the tree of Jesse in the voussoirs of the principal portal. One very well sculptured is seen on the middle portal of the cathedral of Amiens, in the intermediate voussoirs at the right hand on entering. The Jesse (1) is represented asleep according to custom, covered by the Jewish cap; above him is placed king David crowned, and the entire succession of kings. Also a tree of Jesse is seen, sculptured at the beginning of the 13 th century, at the central portal of the cathedral of Laon; one of the 16 th century on the portal of t the cathedral of Rouen, etc. Stained glass of the 12 th century over the entrance of the cathedral of Chartres represents the tree of Jesse, which is one of the most beautiful examples of the art of glass painting at that epoch; there Jesse lies on the bed, at the foot of which burns a lamp. There likewise exists very beautiful stained glass of the time of abbot Suger, representing the genealogical tree in the chapel of the Virgin of the abbey church of S. Denis. These are also found from the 13 th century in the cathedrals of Rheims, Amiens, B Bourges, of the S. Chapelle of Paris. One of the most remarkable examples of the stained glass of the 16 th century, that exists in France is seen in one of the apsidal chapels of the church of S. Etienne of Beauvais, and represents a tree of Jesse; they are also found of the same epoch in the cathedrals of Autun, Sens, etc. They were sometimes carried on corner po posts of houses. Not long since there existed a tree of Jesse on the angle of a house in Rue S. Denis, at Paris. One nearly intact is on the angle of a house at Sens.

JOINT. Joint.

JOINT. Joint.

A vertical separation between two cut stones, filled with mortar or plaster. Each ashlar is always placed between two horizontal beds A B, C D (1) and two vertical joints A C, B D. (Art. construction).

In the constructions of the middle ages, the joints were at first very thick until the 11 th century, and then became very thin, particularly in the southern provinces and in Burgundy, and are nearly without mortar; they becmae thicker toward the middle of the 12 th century, and the stones were set on a bed of mortar without being faced after setting, these joints in mortar not being rubbed with an iron, but simply cut with the trowel. The constructors not cutting the facings no longer rejointed the masonry.

Yet there are some provinces like Auvergne, where during t the 11 th and 12 th centuries, mortar joints were made slightly projecting beyond the surfaces and were cut with sharp edges, as indicated by the section (2); but those joints generally only applied to small stones. For example, they enclosed f facings composed of materials of different colors, forming a around each stone a band about 0.4 in. wide, projecting 0.04 in. beyond the face of the wall. This sort of joints was made after setting, were rubbed and carefully cut with irons. The mortar is very hard, but has not always a perfect adherence to that which served for setting, and that it was necessary to r remove to a certain depth to rejoint.

One likewise sees in th edifices of the end of the 11 th century in the southern provinces adjoining the Centre, like the church of Sa Sernin of Toulouse, for example, projecting joints with convex section (3). Those by not stopping the water that runs down those roofs, are less subject to disintegration by the effect of frost.

The duration of the joints depends much on the quality of t the stone employed. With porous limestones, very rough siliceous limestones, excellent joints are made; it cannot be the same with sandstone, that never adheres perfectly to mortar because of its special aptitude for absorbing moisture. Then mortars dry and rapidly disintegrate. So we have observed in some monuments of Alsace, as for example at the cathedral of Strasburg,[1] that the constructors (to avoid on the inclined planes

or surfaces directly exposed to rain, the disintegration of t the mortar joints, always crumbling and especially near the e external surface), cut at both sides of those joints little grooves to lead the water on he ssrface and protect the mortar from washing.(4).

Note 1.p.148. Face of a buttress of the transept exposed to wind and rain.

In principle, from the moment when one cannot set stones perfectly jointed, as did the Greeks and even the Romans when they employed grand masonry, much better is a thick, than a thin joint, the mortar being preserved only on condition of forming a very considerable volume. The worst joints are cast joints, either in mortar or in plaster. Water evaporating or being ab- absorbed by the stone, the mortar shrinks and there remain c crevices into which enters the dust that produces vegetation. The only method to employ when stone structures are erected, is to set the stones with the lewis on a bed of mortar; caulking is sometimes directed,,as for example in resuming work; b but it requires to be done with extreme care. In this case w when the caulking mortar begins to set, it is necessary to ram it in with iron tools until refusal; then to rejoint some time later to a depth of 2.0 to 2.4 ins. It is well understood, t that what we say here is more applicable to beds than to joints.

The architects of the middle ages frequently imitated joints in painting in interiors, either in red or white on yellow ground, or in white on an ochre ground. (Art. Peinture).

JUBE. Rood Screen. Rood Loft. Ambo. Pulpit.

The rood loft belonged to the furniture of the primitive church; it was then an elevated gallery placed at the choir between that and the believers collected in the nave. From th that gallery were read the lessons taken from the epistles or gospels, and even sermons were preached. Prudentius relates that the bishop instructed the people from the rood loft.[1] G Gregory of Tours describes the rood loft of the church of S. Cyprian.[2] Pope Martin I caused the canons of the council of the Lateran to be read from the rood loft of that basilica. The capitularies of Charlemagne ordained the edicts of the prince to be read there. From the rood loft were also chanted the Hallelujah, the proses or sequences; but that custom

was not retained. From the time of William Durand, men already chanted on the floor, and ascended to the rood loft only on days of great festivals to read the lessons.

Note 1.p.147. Hymn of S. Hypolite.

Note 2.p.147. Book I. Mitroc. Chap. 44.

This is not the place to seek to describe the different sorts of rood lofts, that existed in the churches of the East and West during the first centuries; it is certain that the ambo of the Greek and Latin churches until the 14 th century, was not at all in form what we understand today by rood loft. The ambos of S. Vitale of Ravenna, of S. Mark of Venice, S. L Laurent at Rome, S. Ambrose at Milan, the cathedral of Siena, the church of S. Miniato at Florence, are rather great pulpits able to contain several persons, than rood lofts like those of our western churches, that from the 12 th century at least form a separation, a sort of raised gallery between the upper part of the nave and the back of the choir. In the abbey churches of the West, these rood lofts served thus as a front c closure of the choir of the religious, an enclosure sometimes pierced by three doors, but most frequently by only one. Two stairs ascended to it, one at the right entering at the epistle side, the other at the left at the gospel side; this did not prevent the upper gallery from being in a single extent from one side to the other of the nave, like the gallery. Unfortunately there does not exist in France a single rood loft of an early epoch, and yet our abbey churches and all our cathedrals possessed them, and also many parish churches. However it must be stated that the great cathedrals built about the end of the 12 th century and the beginning of the 13 th, like those of Noyon, Paris, Chartres, Bourges, Rheims, Amiens, Rouen, were not originally arranged to receive rood lofts and enclosures of choirs. (Art. Choeur). It was only about the middle of the 13 th century, that bishops or chapters caused the erection of rood lofts before the choirs of cathedrals. Still Thiers claims that the cathedral of Sens [1] until his ti time possessed a very old rood loft, since he gives it a date of the 8 th century (which is not possible, the cathedral having been built at the end of the 12 th century). But his description is interesting, for it indicates to us that this rood loft, according to the primitive tradition, was separated

into two ambos. "He says, that they are of stone,[2] separate f from each other; the crucifix is between the two.[3] They are supported in front by four stone columns, that form three front arches. Each has its entrance next the choir, and each i its exit next the nave, at both sides of the principal gate of the choir. Most other galleries of that sort have each only one stairs by which one enters and leaves. What is peculiar to the galleries of Sens is that the epistle is chanted in that on the left on entering the choir, and the gospel in that on the right." Not only is it impossible to grant the rood loft of Sens the age given it by Thiers, but it is even very doubtful that this rood loft precedes the 13 th century. Until the 14 th century the cathedral of Sens possessed only one transept, conforming to the arrangement of several great episcopal cathedrals built, at the end of the 12 th century or beginning of the 13 th; it consisted of a single nave wit side aisles extending around the sanctuary with three chapels; one squar e at the apse and two placed at the sides at the height of the existing lower choir.[4] One therefore cannot indicate the place of a rood loft contemporary with the church of the 12 th century. Always following the scheme of the cathedrals of that epoch, one sees only that the enclosure around the sanctuary may have been foreseen. Now there is scarcely a rood loft with enclosure. We therefore cannot regard the opinion of Thiers as sufficiently based to admit, even exceptionally in France, that there existed rood lofts in cathedrals built by the lay school from 1160 to 1230. We shall more readily admit, t that in those edifices could have been erected ambos or great pulpits, like those of S. Mark of Venice, except in style; b but certainly the sanctuary was entirely open and often on a level with the side aisle, as at Notre Dame of Paris, Meaux, Sens, and originally at Senlis. Rood lofts only appeared in c cathedrals after the act of union of the barons of France in November, 1246, i.e., when the bishops were compelled to renounce their claim to have knowledge of all judicial suits under pretext, that every suit resulted from a fraud, and that every fraud was a sin, so that it was for the religious authority to judge actual affairs, personal or mixed, feudal or criminal cases and even simple offenses. By the firmness of the k king S. Louis and by the establishment of his royal bailiffs

and the organization of the parlement, the bishops were compel-led to restrict themselves to their spiritual jurisdiction, or to that possessed by the feudal lords; unable, as they had hoped at the beginning of the 13 th century, to make of the cathedral the seat of every kind of jurisdiction, to content themselves with building episcopal churches, and shutting themselves within their chapters in those vast sanctuaries, erected under the inspiration both political and religious. (Art Cathedrale).

Note 1.p.148. Direct. eccles. sur les jubes des eglises. Paris. 1888.

Note 2. Chapter III.

Note 3.p.148. It is probable that this separation was not such that it was necessary to descend from the right ambo to ascend the left one, since the entirety formed three arches, unless admitting that the middle arch was merely an arch supporting the crucifix.

Note 4.p.148. That arrangement, of which we have found traces very visible in elevation, is confirmed by recent excavations, that M.M.Lance, diocesan architect and Lefort, inspector, had the courtesy to have executed under our eyes.

We have given in Art. Choeur illustrations of rood lofts, those of the abbey church of S. Denis and of the cathedral of Paris. According to those arrangements were erected the rood lofts of Notre Dame of Chartres, S. Etienne of Bourges, Notre Dame of Amiens, cathedral of Rheims, from 1250 to 1500.[1] that of the cathedral of Alby, which dates from the beginning of the 16 th century; those of the church of Madeleine at Troyes, S. Etienne-du-Mont at Paris, S. Florentin of Argues, which s still exist, are remarkable works of the epoch of the Renaissance

Note 1.p.149. All these rood lofts have been destroyed.

There is preserved in one of the chapels of the crypts of N Notre Dame of Chartres the remains of the old rood loft removed in the last century (18 th) by the chapter. Those fragments all belong to the middle of the 13 th century, and are of rare beauty, entirely painted and gilded; they were discovered by the late Lassus, our colleague and friend. We found recently beneath the pavement of the choir of the cathedral of Paris, restored by order of Louis XIV, a quantity of the remains of the rood loft, that dated from the beginniug of the 14 th cen-

century, and was of incomparable refinement in execution. Unfortunatelw those fragments are not sufficiently numerous to be able to restore in certainty and in all parts those charming monuments. Of all rood lofts still possessed in France, t that of the cathedral of Alby is certainly the largest, most complete and most precious; charged with an infinite multitude of sculptures and delicate carvings, it presents one of t the most extraordinary specimens of Gothic art, carried to t the last limits of delicacy and complication of forms. Some churches of Brittany still retain their wooden rood lofts; we cite as the most remarkable that of S. Fiacre at Faouet, which dates frsm the end of the 16 th century. It is entirely painted.

JUGEMENT DERNIER. Last Judgement.

This subject is frequently represented, either in sculpture or in painting, and our churches of the middle ages. But the manner of representation differs according to the time and a according to the provincial schools.

On the portals of abbey churches we see the last judgement first assuming an important place; but in the 13 th century, it appeared in the tympanums of the principal portals of catnedrals, parish churches and even of chapels.

On the portal of the cathedral of Autun, whose erection was about 1140, we see sculptured one of the earliest and most c complete last judgements. Christ occupies the central part of the tympanum; beside him an angel weighs the souls and the d devil awaits the damned. On the lintel at the right of Christ are the elect, who look toward heaven. A colossal angle takes singly the souls of the happy and passes them through a window into a palace, that represents paradise. At the left of the Saviour are the condemned; an angel armed with a spear prevents their communication with the elect. The damned are nude a and hold their heads with their hands. Already in that sculpture the dramatic idea dominates; expressions are rendered w with wild vigor, that lacks neither style nor nobility. But at the beginning of the 13 th century artists are pleased to represent in an extended manner the scenes of the last judgement, and only then do they occupy the tympanums over the doorways, but the lower voussoirs od the arches. The last judgement of the central portal of the cathedral of Paris is one

of those best treated. The lintel is entirely occupied by persons of different conditions leaving their tombs, aroused by two angels at each side sounding trumpets. All these persons are clothed; there is to be seen a Pope, a king, soldiers, w women and a negro. In the upper zone at the middle is an angel weighing the souls; two demons endeavor to depress the scale at their side. At the right of Christ are the elect, all clad in long robes and crowned. These elect are represented as beardless, young and smiling; they look toward Christ. At the left a demon pushes a multitude of chained souls wearing the costumes of their conditions. The expressions of those persons are rendered with rare talent; terror and despair are de depicted in their faces. In the upper part at the centre is seated Christ, who shows his wounds; two angels standing at r right and left hold the instruments of the passion; then are kneeling the Virgin and S. John, imploring the Saviour. The voussoirs at the side of the condemned are occupied at the lower part by scenes from hell, and at the side of the elect by an angel and patriarchs, among whom Abraham holds souls in his lap; then are grouped the elect. That remarkable sculpture dates from 1210 to 1215; it was entirely painted and gilded.

We find the same subject represented at the cathedrals of Chartres, Amiens, Rheims and Bordeaux. But in the last reliefs, the souls are generally represented as nude, excepting the e elect, and the compositions are far from equaling that of Notre Dame of Paris. The dramatic feeling is already exaggerated, the groups are confused, the condemned are grimacing, and the devils are more ridiculous than frightful. Nearly always the entrance of hell is represented by an enormous mouth vomiting flames,into the midst of which demons plunge the damned. In the 14 th century this subject, although often represented, l loses much of its importance; the figures are too numerous and little, and the artists in seeking reality multiply scenes and persons, and have taken from their sculpture that character of grandeur, so well drawn at Paris. Reliefs representing the last judgement are seen on the portal of the library at the c cathedral of Rouen, aud on the principal portal of church S. Urbain of Troyes, that date from the 14 th century, and which by their details, if not by the entirety, still present sculptures treated with rare skill. The glass of rose windows

was often occupied by scenes of the last judgment from the beginning of the 13 th century. Those of the rose window of Nantes, which belong to that epoch, are very beautiful. The south rose window of the cathedral of Sens (16 th century) presents very good paintings of the same subject. But the best paintings on glass of the last judgment, of the epoch of the Renaissance, are those of the S. Chapelle of the castle of Vincennes, attributed to Jean Cousin. There exist some mural paintings of t the last judgment in France; we particularly mention those of the cathedral of Alby, which date from the 15 th century.

KARNEL. (Art. Chateau).

KEMINEE. (Art. Cheminee).

LABYRINTHE. Labyrinth. Maze.

It was customary during the middle ages to place in the middle of the nave of certain great churches a pavement of white and black stones or of colored tiles, forming by their combinations complicated meanders, to which was given the names of labyrinth, road of Jerusalem, or of place. We cannot state the origin of this sort of pavement. M. Louis Paris in his Memoire du mobilier de Notre Dame de Rheims, claims that these pavements were a reminiscence of some pagan tradition; that is possible; yet no mention of them is made in William Durand, or in authors preceding him, who have written on matters concerning churches. The earliest labyrinths known to us not earlier than the end of the 12 th century, and lord de Caumont in his Voyage d'outremer en Jherusalem,[1] in speaking of the labyrinth of Crete,[2] says nothing that can cause one to believe in a tradition of this nature, i.e., he establishes no point of comparison between the labyrinth of the Minotaur and those that he had evidently seen traced on the pavement of the churches of his country. The labyrinth of the cathedral of Rheims is cadded dedalus, meander, place or road of Jerusalem. Some archaeologists have desired to see in those pavements w with combinations of concentric lines a sport of the masters of works, based on this fact, that three of these labyrinths, those of Chartres, Rheims and Amiens, represent in certain compartments the figures of the architects that erected the

cathedrals. We shall refrain from solving the question. One finds drawings of most of those labyrinths in the work of M. Ame, lacced; Garrelages emailles du moyen age et de la Renaissance. M. Vallet in his description of the crypt of S. Bertin of S. Ouen, establishes that the believers must follow on their knees the numerous windings traced by the lines of these meanders, in memory of the passage that Jesus made from Jerusalem to Calvary. The little basilica of Reparatus at Orleansville (Algeria) shows in its pavement a mosaic, that one can take for one of those labyrinths, i.e., a complicated meander. Now that basilica dates from 328, as M. F. Prevost believes. Did that custom come from the East after the first crusades? Or is it a local tradition? We are inclined to think that the re representation of masters of works in these pavements is connected with some masonic symbol adopted by the school of lay masters, since we see those labyrinths appear in the pavements of churches, only at the moment when relegious structures fell into the hauds of that powerful school. If these meanders had been traced to represent the passage of Jesus from Jerusalem to Calvary, it is to be believed that a religious sign would have recalled the stations, or at least the last one; now nothing like this is noted on any labyrinth still existing, or on those of which drawings have remained to us. Further, we find enameled tiles representing combinations of lines in meanders so small, that certainly one cannot follow those complicated ways either on foot or on knees, since some of these labyrinths, like that of the abbey church of Toussaints, are not more than 10 ins. square. Actually the last meanders date from the 14 th century, and may pass for copies of larger works; but again the small or the large contain no religious emblem.

Note 1.p.152. In 1418.published by Marquis de la Grange. Paris. Aubry. 1858.

Note 2.p.41.

LAMBOURDE. Beam. Wall Beam.

A carpentry term that serves to designate a timber placed h horizontally along a wall on corbelr or beside a girder, into which are gained and rest the joists of floors, whose construction remains visible. A (1) is a beam fixed on a wall, and B B are beams beside a girder. In the last case, the beams b being fastened to the girder by means of long iron pins, keyed

bolts or stirrups. (Art. Plancher). The same name is also given to small strips of wood placed on floors and serving to nail the parquetry; but parquetry not being very ancient in France, the name applied to those long strips is very modern.

LAMBRIS. Wainscot. Ceiling.

Only employed in the middle ages to designate a facing of smooth boards. The woodwork of the 13,th, 14 th and 15 th centuries in the interior is frequently covered by wainscot in the form of round or pointed tunnel vaults. This is then ceiled carpentry.(Art. Charpente). This ceiling was always covered by paintings more or less rich. One still sees many in Brittany, Normandy and Picardy. The great hall of the palace at Rouen is covered by a wooden ceiling. The hall of the hospital of Tonnerre likewise possesses an enormous ceiled roof (Arts. Hotel-Dieu, Salle). Also frequently the lower walls of halls or chambers were wainscoted, i.e., by boards with battens below the tapestries. This wainscot was detached from the wall and nailed on furring strips fastened with plaster in the chases A. (1). Thus was avoided the dampness of the walls, always quite dangerous in houses.

LANTERNE DES MORTS. Lantern of the Dead.

A hollow pier or one terminated at its summit by a little structure with a window and a little door at its base, designed to indicate afar at night the location of a religious establishment or a cemetery. (Old French text).[1]

Note 1.p.155. La Chronique de Reins (13 th century), published by Louis Paris. Paris. Techener. 1837.

The provinces of the Centre and West of France still retain quite a great number of those monuments, so as to cause the supposition, that they were formerly very common. Perhaps one should seek in these structures an ancient tradition of Celtic Gaul. Indeed these are the territories in which are found the raised stones or menhirs, which present very frequent examples of lanterns of the dead. The words lantern, pharos and burning pharos,[2] have etymologies that indicate a sacred place, a structure, a light. Later, laterina in Latin signifies brick, ingot, rock, mass of bricks; pharos in Greek is luminous, a torch; phanes, the god of light; fanum, a consecrated place;

par in Celtic, a consedrated stone; fanare, to recite formulas of consecration. The Celtic deity of Cruth-Loda inhabited a p palace whose roof was strewn with nocturnal fires.[3] Even in our days in some provinces of France, elevated stones, whose erection is attributed to the Druids, erroneously in our opinion,[4] pass for self-illuminating at night, and for healing the sick, who sleep near them in the night preceding S. John. The stone of the maples (Touraine) among others, prevents nocturnal teerors. It is well to note that the menhir of the maples has a hole pierced in one part, like several of those elevated stones. Were not those holes arranged to receive a light? And if they must receive a light, were they pierced by the people that originally erected those blocks or later? Whether the m menhirs were stones consecrated to the light, the sun, or were preservative stones intended to avert sickness, to drive away evil spirits, or were boundary stones, traditions of the travels of the Tyrian Hercules, it is always the case that the lantern of the middle ages, habitually accompanied by a small altar, seems to have been a sacred monument of a certain importance, particularly in the Celtic provinces. It existed at the gates of monasteries, in cemeteries, and principally at the side of roads and near hospitals. One may then admit, t that the lanterns of the dead erected on the soil formerly Celtic have perpetuated a very ancient tradition, modified by Christianity.

Note 2.p.155. There existed a burning pharos near Poitiers, on the site of S. Hilaire, at the time of the battle of Clovis against Alaric.

Note 3.p.155. Edward, Recherches sur les langues celtiques; (See the work of L. A. Labourt, Recherches sur l'Origin des ladreries, maladreries, etc.

Note 4.p.155. This is not the place to discuss this question, which we propose to treat elsewhere. We must say only that we regard those monuments as belonging to traditions preceding the domination of the Celts.

The first apostlesof Gaul, Brittany, Germany and Scandinavian countries experienced insurmountable difficulties, when they tried to cause the peoples to abandon certain superstitious practices. They were frequently compelled to give to those practices, which they could not destroy, a different aim

and divert them, so to speak, for the benefit of the new religion, rather than to risk compromising their apostolate by an absolute disapproval of those traditions so deeply rooted. M. de Caumont thinks [1] that these lanterns of the dead during the middle ages were especially intended for the service for the dead brought from afar, and that were not taken into the church. He admits then that a service occurred in the cemetery, and that the lantern of the dead took the place of the wax c candles. That opinion is shared by M. abbe Cousseau;[2] "The mother church alone," says M. Cousseau, "possessed without r restriction all the rights attached to the exercise of worship. That resulted from this, that frequently the lord in making a donation of the church to a religious body, made this restriction on his liberality, that the right of the tithe, the right of burial, was not comprised in the gift." That lanterns of the dead were utilized for the funeral services in cemeteries seems probable; but that men erected columns several yards high to palce at their tops in full daylight l lighted lamps, whose light could be perceived by none, and this only with the intention of replacing lighting by wax candles, is doubtful. If the lanterns of the dead had been intended only to take the place of wax candles during interments, it would have been more natural to make them very low, and so arranged that the light could be seen in the daytime by those present. Quite on the contrary in these little monuments, that seem designed for the lamp enclosed in their upper lantern to be seen very far at all points of the horizon. M. Lecointre, archaeologist of Poitiers,[3] remarks that "the hollow columns or lanterns were especially erected in cemeteries bordering on the principal roads of communication, or were in much frequented places. He thinks that these lanterns were intended to preserve the living from the fear of ghosts and spirits of darkness, to protect them from this nocturnal fear, from that form walking in darkness mentioned by the Psalmist; finally to invite the living to prayer for the dead." As for the idea attached to these monuments, for examfle in the 12 th century, M. Lecointre appears to us to be right; but we are no less d disposed to believe, that these columns belong by tradition to the customs or superstitions of very high antiquity.[1] It is to be regretted, that no lanterns of the dead preceding the

12 th century remain to us: their existence is not to be doubted, since mention was made of them sometimes, among others at the battle of Clovis and Alaric, but we do not know the f form of those first Christian monuments.

Note 1.p.156. Cours d'antiquitées. Vol. VI.

Note 2.p.156. Bull. monum. Vol. IX. p. 540.

Note 3.p.156. Bull. monum. Vol. III. p.452.

Note 1.p.1-8. To give here only a small number of examples of the antiquity of that tradition, Herodotus relates, that in the temple of the Tyrian Hercules, there was an isolated column of emerald (carbuncle), that of itself lighted the entire interior of that temple. The geographer Pomponius Mela claims that on the summit of Mt. Ida, celebrated in antiquity for the judgment of Paris, there was seen the gleam of night fires, which gathered in a sheaf before the rising of the sun. Euripides says the same thing in the Trojan Women.

One of the best preserved lanterns of the dead, dating from the 12 th century is seen at Celfrouin (1). The little door for introducing, lighting and hoisting the lamp, is elevated 13 ft. above the circular platform on which rises the structure; which fact assumes it necessary to use a ladder to light tha t lamp and raise it to the top of the flue. The lantern of Celfrouin, contrary to the adopted custom, has but a single opening at the top, by which one can perceive the light of the l lamp. As for the little shelf placed beneath the lower opening, it cannot be regarded as an altar, but only as a rest f for placing the ladder and the lamp to arrange it before raising it.

Another lantern more complete than this, is found in the v village of Ciron; it dates from the end of the 12 th century. Placed on a broad platform raised 7 steps above the ground, it possesses an altar table, and at the right of that table is the opening necessary for the introduction of the lamp. (2). That opening was closed by a wooden shutter. We give at A the plan of the monument of Ciron; at B is the plan at the level of the altar, and at C at the level of the upper lantern. Fig. 3 presents the elevation and section of the monument, s still preserved well today. The lantern is open, so as to allow the light to be seen from all parts of the horizon. Fig. 4 presents the perspective view and plan of the lantern of the

dead of Antigny, which dates from the middle of the 13 th century. According to custom, the monument rests on the platform of these steps; it is on a square plau, possesses its little altar with one step, a lateral door for the introduction of t the lamp, and four openings at the top to allow the light to pass. The top was probably terminated by a cross like the two preceding examples.

The lanterns of the dead lose their character of elevated stones, and the isolated column during the 14 th century, a and are replaced by little open chapels in which was held a l lighted lamp. (Art. Chapelle, Fig. 20). So that the old Gaulish traditions, that were perpetuated through Christianity until the end of the 13 th century, gradually changed form until their origins were forgotten.

LARMIER. Geison. Corona and Facia. Cornice.

A moulding taken in the height of a course forming a band or the upper member of the cornice, and designed to protect the surfaces by casting the rainwater away from the wall.

The geison of the Roman cornice has only a slight undercutting A (1) made beneath the projection of the projecting member of the cornice; consequently the rainwater before leaving the protecting stone follows the wash a b, fillet c, corona d and facia e. This principle is nearly followed during the Romanesque epoch, and even frequently then the projection being omitted, the water without obstacle washes the entire moulding to the surface of the wall, that those mouldings should protect. If the lay school of the end of the 12 th century subjected all parts of the construction to absolute reasoning, it did not neglect these mouldings; in execution of this it abandoned Romanesjue traditions; it invented profiles in accord with recognized necessities, as it invented a system of construction based on new principles. That school then gave to t the cornices, i.e., to the courses protecting the surfaces, t the profiles most favorable to the rejection of the water. T This profile consisted (2) of a wash A, terminated at bottom by a drip B, sharply undercut. If it was desired to throw the drip water farther from the surface, there was added a moulding beneath the drip. (3). (Art. Corniche). This principle was f followed during the 13 th, 14 th and 15 th centuries; toward

the latter time, men wished to give more lightness to the wash, and instead of cutting it plane, it was made concave (4). But since that evidently weakened the stone, and also the fillet A seemed wide beside that curved surface, they came to profile the edge of the cornice or drip according to the sketch (5), about the end of the 15 th century. The drip moulding persisted long also in the architecture of the Renaissance; because indeed this profile was certainly most suitable to ensure the surfaces under a climate where rains are frequent. As a general rule, the fillet B of the moulding is always drawn perpendicular to the line of the wash. These mouldings are strong and thick in the architecture of the 13 th century of Ile-de-France; they are more refined and lower in Champagne; they o only appear quite late (about the second half of the 13 th century) in Burgundy, and then they always take the form of a slab with wash and with the deep drip beneath the wash.

LATRINES. Privies.

The word "latrines" is only used in the plural. It is freely admitted that our ancestors in their houses, palaces and castles, had none of those conveniences, that today one cannot do without (at least in the cities of the North); and that in Versailles the lords of the court of Louis XIV found themselves in the necessity of relieving themselves in the corridors, for lack of closets, from which it is concluded, that with the dukes of Burgundy or of Orleans in the 15 th century, men did not even take such precautions.[1]

That negligence in satisfying the necessities of our physical nature was carried very far in the time, when men particularly thought of producing noble architecture. Not only the chateau of Versailles, where the court resided during the 18 th century, contained only such a limited number of privies, that all the personages of the court must have pierced seats in their wardrobes; but much smaller palaces did not have any whatever. Not long since all the apartments of the Tuileries were without closets, so that each morning it was necessary to have made a general removal by persons for that purpose. We remember the odor disseminated in the time of king Louis XVIII in the corridors of S. Cloud, for the traditions of Versailles were scrupulously retained there. This fact relating

to Versailles is not exaggerated. One day when we were very young and visited that palace with a respectable lady of the court of Louis XV, passing through a pestilential corridor, s she could not preven an exclamation of regret; "That smell recalls to me such a very fine time!"

Yet if the castles of the middle ages did not present facades arranged for beautiful symmetry, colonnades and pediments, they possessed privies for the lords as for the garrison and servants; they had as many as necessary and very well arranged. At Coucy the towers of the keep of the beginning of the 13 th century have privies in each story, constructed to avoid odor and all inconveniences connected with that necessity. The privies of the keep discharge into a large and well built cesspool, that could be emptied without inconveniencing the enhabitants. As for the privies of the towers, they were placed in the reentrant angles formed by the junctions of those towers and the curtains, casting all sewage outside on the wooded p precipice that surrounded the castle.

Here is one of those privies opening from a landing A communicating with the halls and stairs. B is the curtain, C the tower. From B to D is built a wall corbelled out and covering the seat E. At F is a urinal and at G the window. The sketch H gives the appearance of the privy externally, the sketh I is its section on A X. No odor is to be feared, since the sewage falls on the precipice.

Fig. 2 presents a privy that still exists intact in the castle of Landsperg (Lower Rhine),[1] and like those of the towers of Courcy casts all sewage outside. The seat is entirely corbelled from the face of the wall. Fig. A gives the plan, Fig. B the section, and Fig. 6 the view of the corbelling of the seat with the discharge in perspective. Since there might be reason to fear arrows, that might be shot from outside, one w will note that the constructor had the precaution to place a front slab descending below the two side corbels, so as to entirely protect the legs of the person on the seat, and formed of a simple perforated slab. At night when one went to the p privy, it was the custom to be accompanied by a servant bearing a torch. That custom seems to have been abandoned only v very late. Gregory of Tours relates that a priest died in the privy, while the servant that accompanied him with a torch,

waited behind a portiere that fell over the entrance;[2] and in the Memoires of Jehan Berthelin written about 1545, we read t that a knight of the king, lodged at Rouen at the inn of the Cheval Blanc, that having risen and gone to the privy with a servant of the said lodging, both fell through the said privy and were drowned there.[3] In the Cent Nouvelles nouvelles, t there is also mention of personages, who were accompanied by servants. That explains why in the privies of the middle ages a large space was left before the seats, or often a sort of rather long passage between the seat and the entrance.

Note 2.p.164. Book II. Chapter 23.

Note 1.p.164. This drawing was furnished to us by M. Cron, architect. This castle dates from the 12 th century.

Note 3.p.164. Journal du bourgeois de Rouen; Revue retrospectif normande. Pub. by Andre Pottier. 1842.

Cesspools were the object of special attention by constructors; we have numerous examples of them in the castles of the middle ages. They were vaulted in stone, with ventilation and openings for emptying. But particularly in the construction of common privies that the architects made proof of care. In castles having to contain a very great garrison, there is always a tower or separate building reserved for placing the privies. At the castle of Coucy between the great hall and t the kitchens were important privies whose cesspool is preserved. One sees remains of privies arranged for numerous garrisons in one of the three castles of Champigny (Poitou). In England the castle of Langley (Northumberland) exists a four story building intended for privies, that were established in a very monumental manner. One sees very fine and large ones at the castle of Marcoussis, nearly like those of Langley. The privies of the castle of Marcoussis, built in the 13 th century, against one of the curtains, consist of narrow covered st structures without floors, whose privies (3) [1] communicate with the stories of the adjoining structures by means of doors and passages (see cross section A). The cesspool was at C, and i its vault was composed of two transverse arches between which passed the three flues from the three stories of seats. Those seats were four in each story, and from the ground D (ground story) to the roof, placed about 3.3 ft. above the upper window E, there were no floors. Thus ventilation could easily o

occur, and the odor was not carried through the doors B into the adjoining buildings. At F we have traced the section of t the building parallel to the seats, and to show them, we have assumed the balustrades G to be partially removed.

Note 1.p.107. After an old drawing in our possession.

At the castle of Pierrefonds, whose construction dates from 1400, there is a tower Beside the barracks of the garrison, for the privies and that was entirely destroyed. We give (4) sketches of that singular structure. At A is reproduced a plan of the tower at the level of the soil outside the castle, which is the ground of the ditch; at C is an opening for removal; at D the ventilator, and at E the mass of cut stones pl- placed at the centre of the cesspool to facilitate removal of sewage. Sketch B gives a plan of the second story (ground story for the court of the castle). From the halls G one could reach the privies only by the long corridor F with two doors. the hall H possessed a row of seats at I and a flue L to discharge from the privies of the two upper stories. The perspective section made on B K shows at M the cesspool with the mass N and ventilator O; at P are the seats of the ground story; at R the seats of the second story, and at S the seats of the third story. To show the floors of all the seats, we have assumed the floors removed. The last flue S is extended by a l lateral flue up above the roofs, so as to produce a draft, a and near the extension pipe of that last flue was arranged a little hearth to increase that draft. It must indeed be recognized that many of our establishments occupied by many persons, such as barracks, colleges and seminaries do not have privies so well arranged as these. Note that by the lateral opening for removal of the central mass, it was very easy to clean out often and quickly; that this central vault contained a considerable volume of air; that it was doubly ventilated, and that consequently not much gas could pass into the rooms, which were ventilated by windows; that also all entrances arranged in the different stories of this tower consisted of long and bent corridors, themselves ventilated and closed by double doors.

In the same castle the privies of the great residence of t the lords or the keep are arranged with extreme care in a narrow part of the building and receive air from both sides, is-

isolated and opening the windows of the privies to the North. (Art. Donjon, Figs. 41, 42, 43). It is necessary to state that the windows of the great privies for the garrison jus illustrated in the preceding Fig. likewise open to the North. These minute precautions devoted ts the construction of these important parts of habitations give place to extreme negligence, toward the end of the 16 th century. But then men were preoccupied first of all, in producing what are termed beautiful and symmetrical arrangements; that the convenience of the inhabitants of a palace or house, what we call comforts, was subject to architectural conditions made rather for gods than simple mortals. In closing, we must not omit to warn our readers against the tales of oubliettes (dungeons) told by all guides charged to conduct amateurs of feudal ruins. Nineteen times out of twenty, those oubliettes, that so vividly move visitors to castles of the middle ages, ane common privies, just as certain torture chambers are kitchens. We have several times seen the cleaniug of the cesspools of castles, that were regarded with respectful terror, as having ingulfed unfortunate men; mingled with much sewage are found a quantity of the bones of rabbits and hares, some coins, potsherds and dead cats in abundance.

LAVABO. Lavatory.

A great basin of stone or marble with water flowing from a number of little orifices pierced around its edge, into a lower basin, and designed for ablutions; by extension the name of lavatorw has been given to the room or area in the midst of which rose the fountain. Most cloisters of religious possessed a lavatory. Sometimes it was placed at the middle of t the court under the open sky, more frequently beside one of the porticos of the cloister or in an angle, and then the lavatorw was covered; this was an annex of the cloister toward which the religious passed before entering the refectorw and on returning from the labors in the fields, when they worked there. The Cistersiaus in the 12 th century prided themselves on returning to the first rigors of the monastic life, who e excluded from their monasteries everw luxury aud superfluity, still constructed lavatories in their cloisters,not arranged as a motive of decoration, but as an object of primary necessit

Indeed the Cistercians of the 12 th century occupied themselves in rude manual labor; it was necessary for them to wash off the dirt covering their hands before entering the church or the refectory. Thus we see that the lavatories of Cistercian monasteries are an important part of the cloister. The a abbey of Pontigny possessed a lavatory whose basin still exists, that of Thoronet, 12 th century, on the contrary, possesses a structure that contained the basin,,while that has disappeared.

Here is the plan of that lavatory; it is a hexagonal room a adjoining the portico of the cloister extending beside the r refectory; the religious entered the lavatory by one door and left it by the other, so as to avoid all disorder; thus they ranged themselves around the basin to the number of 6 or 8 to perform their ablutions.

Fig. 2 presents the section of that lavatory on a b.[1] Conformably to the rule of the order of Citeaux, that room is extremely simple, covered by a stone dome of 5 sides with ribs in the reentrant angles.

Note 1.p.171. See the engravings made after the drawings of M. Questel, in Archives des monuments historiques, published under the auspices of the minister of State.

The abbey of Fontenon near Montbard depended on the same o order, and possessed beside a portico of its cloister a lavatory of remarkable construction. (3).[1] 7t A was the refectory. The religious filed into the lavatory by one arch and left by the other at Theronet. A central column passing through the basin B supported the imposts of four cross vaults with transverse arches. This hall was sufficiently spacious to allow 15 religious at least to stand around the basin, was low like th the porticos of the cloister, and consequently was sheltered from wind and sun.

Note 1.p.172. There are still seen in place the two entrances of the lavatory, and we found in 1844 among the rubbish scattered in the cloister, fragments of the piers of the hall, whose perimeter appeared above the ground of the court.

Fig. 4 presents a perspective view of this lavatory haken f from the point C, assuming the vault out from a to b. This w was an edifice whose a rangement was rigorously made according to the given programme, and that must present a pleasing

appearance, although its architecture was very simple. The be beautiful limestone materials at the disposal of the religious of Fontenon permitted them to erect this hall with large blocks of stone; the nucleus of the piers is monolithic, the bases and capitals are made of a single course. This mode of c construction added to the grand character of the monument in spite of its small dimensions. The abbey of S. Denis possessed a very beautiful basin in its cloister, that served for the a ablutions of the monks; that basin is now deposited at the m middle of the second court of the Ecole des Beaux Arts, dates from the 13 th century, and has a remarkable profile, and presents entirely around it between the jets a head sculptured in beautiful style.[1] When the monks could not conduct water into the basin for the daily ablutions, thew contented themselves with a well with a circular or semicircular trough around or near it.

Note 1.p.174. See the engraving of that basin in Examples de decoration of M. Leon Goucherel.

Note 2.p.174. See the cloister of the cathedral of Gerona.

Still in Spain the monasteries possessed magnificent lavatories. The vicinity of the Arab establishments, in which an abundance of water was regarded as a necessity of the first order, must have exercised a certain influence on the construction of the cloisters. Also in the monasteries of the south of France one formerly lavatories best arranged and most spacious. It is to be regretted that those halls, that lent themselves so well to architectural compositions, have been destroyed e eveeywhere, from before the end of the last (18 th) century, by the monks themselves, who no longer submitted to the rule of washing themselves together at the same time. Lavatories sometimes consisted only of a great trough of marble, stone or bronze, placed at the entrance of the refectory. (See Art. Lavoir in the Dictionnaire du Mobilier).

LAVATOIRE. Lavatory for the Dead.

A trough placed in a room near the cloister of a monastery, and serving to place and wash the dead before burial.

The custom of washing the dead before interring them is a practice that dates back in antiquity,[2] and that was retained until the end of the last (18 th) century in some provinces,

as for example in the Basque country, the suburbs of Avranches and Vivarais. Lord de Moleon [4] thus describes the lavatory of the abbey of Cluny:- "In the midst of a very spacious and very long chapel, where one enters the chapter from the cloister, is the lavatory, which is a stone 6 or 7 ft. long hollowed some 7 or 8 ins. deep, with a stone pillow of the same block as the trough; with a hole at the end of one side at the foot, through which the water runs after the washing of the dead." The author gives a drawing of that lavatory, which we present here (1); he adds that there are similar stones in the hospital of the city of Cluny, in the chapter of the cathedral of Lyons, in the vestiary of that of Rouen, and on nearly all monasteries of the orders of Cluny and of Citeaux.

Note 3.p.174. See Acts of the Apostles, Chap. 9; Sidonius Apollinore. Book III. Letter 3.

Note 4.p.174. Voyages liturgiques en France. Paris. 1718.

LEGENDE. Legend. Story.

This word in architecture is applied to grouped representations, either sculptured or painted on the wall or on glass, of legendary subjects, as for example the story of the prodigal son, the story of the bad rich man, or indeed certain lives of the saints related in the Legende doree. The portals of our cathedrals of the middle ages frequently present legendary subjects sculptured on their bases dating from the end of the 13 th century. At the cathedral of Auxerre, on the portal of the Calende of the cathedral of Rouen, on the western portal of that of Lyons, are seen very fine sculptures representing legendary subjects. But especially on glass extend the innumerable series of this sort of subjects. (Art. Vitrail).

LICE. Lists. Barrier.

A barrier or palisade, and by extension the space reserved between the two enclosures of a fortified city, or between the walls of the external barriers. (Art. Architecture Militaire). The name of lists was also given to the enclosed fields intended for exercises, jousts, tourneys, passages at arms and judgments of God.

When an army encamped and surrounded itself by a palisade, one said "leave the lists" instead of leaving that palisade.

When Harold came from London before William the Bastard, he caused his army to be placed behind palisades. On the morning of the battle, Harold went to reconnoitre the enemy. (Old French poem).[1]

Note 1.p.175. Roman de Rose. Verse 12, 123.

After the battle of Mansourah or Massoure, spies came to w wanu S. Louis, that he would be attacked very early the next morning in his camp. (Old French text).[1] Thus in a camp made with haste, the piles forming the barries were spaced apart so as ts permit men on foot to pass between them. Those piles thus formed a series of merlons, that did not prevent the infantry from throwing themselves on the assailants, but which stopped cavalry charges, and allowed the soldiers to rally, if they were compelled to retreat.

Note 1.p.176. Hist. de S. Louis. Joinville. Published by M. F. Michel. 1858.

Castles were always surrounded by barriess, i.e., bu barriers of palisades, sometimes with ditches, that protected the foot of the ramparts, and allowed men to make the rounds outside, when it was invested. That was a tradition of the warlike peoples of the North. (Old French poem).[2]

Note 2.p.176. La prise d'Orenge, William of Orange, ballad of the 11 th and 12 th centuries; published by M. W. J. A. J Jonckbloet. 1854.

This means that the castle of the city is of masonry, vaulted and enclosed by a wooden palisade.

LIEN. Strut. Brace.

A term in carpentry. - wooden timber having a tenon at each end, and that is set obliquely and connects the kingpost with the principal or with the ridge of the carpentry of a roof. (1). A being the kingpost, B the principals, the timbers C a are braces; D being posts and F the ridge, the tembers G are braces.

LIERNE. Ribs. Purlines.

Ribs of a cross vault that connect the crown of the diagonal arches with the crowns of the side diagonal arches (tiercerons). The ribs A (1) are liernes. (Arts construction, Voute).

In carpentry the tiebeams (liernes) are horizontal pieces of

wood connecting at their base two kingposts lengthwise the roof, to receive the boists of the false floors. They are also curved timbers placed horizontally between the principals of a conical roof, and which serve to receive the rafters, when these are to be spaced at nearly equal distances in the height of the roof. The timbers A (2) are liernes. In the roofs of cylindrical towers, these are necessary when the carpentry is not arranged so that each refter is trussed. The method of trussed rafters being nearly always adopted in the carpentry of roofs of the middle ages, it is rare to have recourse to liernes. Since the 1i th centurw they have been employed for spheroidal carpantry forming a dome.

LIMON. String of Stairs. Horse.
An inclined timber that supports the steps of a stairs at the end opposite the wall (Art. Escalier). Stone strings not being employed in the architecture of the middle ages, the w winding steps in stairs of square or rectangular plans being always supported on arches, this is much more stable than the system of masonry strings.

LINCOIR. Lintel. Header.
A carpentry term. Wooden timber placed horizontally over d dormers or chimney caps to receive the rafters of the roof.

LINTEAU. Lintel.
A block of stone laid on the jambs of a door or window to form the upper part. In carpentry a horizontal wooden timber that fulfils the same purpose is also termed lintel. (Arts. Fenetre, Porte.

LIS, FLEUR DE. Fleur-de-Lis. Art. Flore.

LIT. Bed.
Horizontal setting surface of a cut stone. Each cut stone is comprised between two beds, the upper and lower beds; naturally the upper bed of the stone receives the lower bed of the one next above. The Greeks set their materials dressed w with dry joints, marble or stone, and without mortar. In great masonry the Romans did the same, and that with such perfec-

perfection, that in Greek and Roman structures built of cut stone or marble, one scarcely perceives the joint between the blocks. This method was sometimes imitated during the middle ages, particularly in countries where there existed a great number of antique monuments, as in Provence and Languedoc; but the imitation is very far from attaining the perfection of the antique stonecutting in regard to the beds. In the provinces of the Centre and North of France mortar was employed between jointed stones from the Merovingian epoch. The beds of mortar are very thick from the 7 th to the 12 th centuries; they became thinner and regular at that epoch, receiving a t thickness varying from 0.4 to 1.2 ins in the 13 th century, when were erected great religious edifices, castles and palaces; they they again became thinner during the 14 th and 15 th centuries, but always retaining a maximum thickness of 0.4 in. As for the cut beds, they are plane, well dressed and without holes from the 12 th to the 16 th centuries. In the structures of the middle ages the beds are dressed with as much care as the faces.

Men call the stone set on edge, when the quarry bed is vertical instead of being horizontal. Limestones are formed by a series of deposits, marine, lake or river, and thus consist af superposed more or less homogeneous layers. When these layers have not been strongly cemented naturally, they tend to separate. It is then important to set stones on their quarry beds, i.e., conformably to their geological positions. Yet t the Romans and the constructors of the middle ages did not commit a fault in employing limestones set on edge, but then they chose with care those, that could assume that position without danger. (Arts. Construction, Joint).

LOGE. Loggia. Bay Window.

A room or portion of a gallery belonging to a public or private edifice, raised above the external ground and opening w widely to the exterior without glass or permanent enclosure. The loggia partly resembles the portico, partly the gallery, still it is necessary to distinguish it from those two architectural members. The loggia differs from the portico because it is raised above the public street, possesses a special entrance, and its length is limited, while the portico is cover-

covered and of indeterminate length. The loggias belonging to houses differ from the corbelled gallery in the important point, that this is enclosed by glass sashes or shutters, and adds to the rooms an annex projecting on the public street. The French architecture of the middle ages scarcely accepts the loggia except in the southern provinces, where it can have a certain utility. In our climates, one always prefers an enclosed room to those halls open to all winds, so common in th Italian cities of the 13 th and 14 th centuries. Italian municipalities freely erected those edifices suitable for assemblages of citizens, covered by vaults or wooden ceilings, to a avoid the rays of the sun. In those loggias the merchants came ti talk of their affairs, as today in exchanges and clubs. O One readily conceives that in France the parlors, that correspond to the great loggias of Italy, must be enclosed for nine months of twelve; therefore they were only halls more or less vast. Also likewise in our houses it was rare to find under the roofs those loggias, that custom causes to be opened at the tops of Italian habitations, and that are arranged for br breathing the cool air of evening. Yet the loggia was not absolutely banished from our northern habitations. There still existed a few years since on the square of the cathedral of Laon a small house of the 13 th century, formerly belonging to the chapter, that possessed a loggia at the base of its roof, arranged with a shed roof and stopped at the corners by turrets.

Fig. 1 gives a perspective of the facade of that house. At the base of the roof and recessed was constructed in wood a l loggia, that returns to the two eave walls, and then passes under the roof. It was like the defensive gallery with its wa watch towers.

Fig. 2 presents at A the plan of the facade of the house, of the story beneath the loggia, and at B the plan of that loggia. The adjoining loggias of the roof take the name of "soliers",(eave galleries), like the roofs themselves; they serve for defense, permit seeing all that passes outside, and afford an excellent drying place for the occupants. Note that those eave galleries are low, well sheltered and closed at the ends.

In the vicinity of the market-places were also sometimes es-

established loggaias elevated but little above the ground of the public street beneath several houses to allow the merchants to conduct their affairs under shelter from sun and rain. There still exists at Vire a small loggia of that kind arranged beneath a house of the 14 th century. Nothing is simpler than that structure (3), which consists of two piers and two stone columns resting on a low wall; with a paved area and s some steps placed at each end next the public street. The facade of the house is of half timber work filled in with brick and rests on the piers and columns, so that this loggia is n nothing but a raised portico with a low wall beneath its columns.

On the facades of city halls, palaces, mansions of wealthy private men, sometimes though very rarely in France, are loggias arranged like projecting bay windows, i.e., supported on corbels. By their small dimensions these loggias, properly speaking, are only covered balconies. They were less rare in the provinces of the East and Southeast than in Ile-de-France, the provinces of the West and Centre. Some houses of Dijon f formerly possessed them; they were found at Metz, Verdun and on the banks of the Rhine, as proved by numerous engravings of the 16 th and 17 th centuries. These corbelled loggias or rather open bay windows, were placed over the doors of houses in the second story, thus forming a sort of hood over the entrance.

We give (4) one of these that we found very well in a French manuscript of the 15 th century in the library of Munich. It was entirely made of stone, covered by lead, and placed over the doorway.

The wars in Italy at the end of the 15 th century inspired French lords with a taste for loggias; but the architects of the beginning of the Renaissance, who retained the sensible traditions of the art of our country, decided with difficulty to give them the appearance of a structure open at three sides; they rather treated them as low porticos of reduced length, opening only in front.

At the top of the stairway of the Chambre des Comptes in P Paris, there was thus a vestibule without glass, that could well pass for a loggia (Art. Escalier, Fig. 3). That vestibule consisted of two bays opening on the court of the S. Chap-

Chapelle; its arches were without glass like those of the stairway, and were flanked by buttresses decorated by statues.[1] The loggia, a first vestibule of the chamber, was very rich, as one can judge by our Fig. 5, which gives an external perspective. Below in the ground story was the doorway of the l lodging of the first bailiff and of the receives of fees. The great covered landing that we give here as a loggia took the place of the little waiting hall. We possess at Paris a monument very remarkable by the style of its architecture, and that was treated in the style of the Italian loggias, the monument made into the fountain of the Innocents. That loggia consists of three arches, two in front and one in return; In the substructure, below the arch in return, on the outside was a fountain. Balustrades were found between the piers.[2] The loggia of the fountain of Innocents was erected at the corner of Rue S. Denis and of Rue aux Fers. Pierre Lescot was the architect and Jean Goujon the sculptor. In 1785 it was taken down by pieces, and it was made the monument that we have seen restored recently somewhat, a monument to which it is now difficult to assign a meaning, for one does not understand well w why men had the idea of placing a flowing fountain at 19.7 or 26.3 ft. high above the ground, and why when placing it so h high, it was judged necessary to have it flow beneath a dome, under shelter from the rain. One accepts a covered fountain, if it be in reach of passers, but a jet of water crowning a pyramid of basins certainly has no need of an umbrella. After all, the charming sculptures of the monument remain to us, and there would be a bad grace in complaining of the strange transformations suffered by the architecture of Pierre Lescot.

Note 1.p.185. See the works of Israel Sylvestre, Merion, & and in the Topog. de la France, Imp. Library, the great drawings of the facade of the Chambre des Comptes.

Note 2.p.185. See the works of Israel Sylvestre.

LUCARNE. Dormer or Luthern Window.

An opening made in the slope of a roof, destined to light the attic. During the middle ages dormers were made with stone fronts, others being entirely of wood, visible or covered by lead or slates. Dormers however were adopted only when the roofs had assumed great importance. During the Romanesque pe-

period, the carpentry of the roofs being generally flat, there was no opportunity to light them by dormers, since lodgings could not be arranged there; but from the 13 th century habitations were crowned by roofs forming at least an equilateral triangle in section; the lower part of those roofs was utilized by constructing these chambers lighted anf vaulted by domes. Later was given the name of mansards to these windows,(?), and to Mansart has been given the honor of regarding him as t the inventor of these openings, which existed on all public and private buildings in the North long before him.

We shall first occupy ourselves with dormers whose stone f fronts rest on the cornice in the plane of the wall. The 13 th, 14 th and 15 th centuries furnish us with a great number of examples of this kind of openings, composed of two jambs with sill and a lintel terminated by a gable and a tympanum. These dormers with stone fronts are generally too high for a person to approach easily and look out into the street; their openings are even fitted with a transom bar of stone, as in the example given here (1).[1] The jambs are abutted by two buttresses that give them a bearing on the top of the wall; little gargoyles extend around these buttresses and cast the water from the v valleys into the gutter A existing between the dormers and f furnished with great gargoyles. The lintel of one stone bears with it the two little side gables. A second block of stone f forms the apex. The copings of the gable have drips before a and behind, so as to cover the slate roof B of the dormer. Re Reveals are recessed on the jambs; this kind of dormer is common in the 13 th century. Sometimes, though rarely at that i epoch, the tympanums are decorated and the copings have crockets. Yet these crownings of edifices, outlined on the roofs, do not delay in receiving a very rich ornamentation. It was customary during the second half of the 13 th century and u until the 16 th to place great halls beneath the roofs. These ceiled halls could only be lighted by very high dormers extending down to the internal floor placed below the external cornice, and interrupting that. The carpentry was composed only of trussed rafters, whose collar beams were fastened to the principals extending down to the blocks.(Art. Charpente, Fig. 26). The importance of these dormers (Luthern) required particular care in their construction, for it was necessary that

their stone fronts could support themselves, that they should receive the penetrations of the carpentry, and all leaks of rainwater should be avoided between the stone and the roofing. According to the customs of building by the architects of the middle ages, these precautions relating to the stability of t the construction of the very different materials are minutely observed. We have in our time replaced this care in the study of details by quite rude means, such as plaster furrings and zinc junctions; but also it is necessary to continually send the roofers to repais the primitive defects of the badly studied construction, or at least in order to finish the work in a tolerable manner, to have the masons follow the roofers several times at these delicate points, the roofers the masons also at several times. In those old times of ignorance, when the mason had finished his work, there came the carpenter and then the roofer; each found matters so arranged as to not have to return when the last slate and last cresting were placed. Fig. 2 shows one of those great dormers of ceiled roofs. At A we give its horizontal section made at the level a b of the face B. The cornice of the building with its gutter is at E; the front of the dormer is abutted laterally by the buttress F and behind by the pilasters G, against which are attached the carpentry sides. Little channels H collect the water from the roof, that runs along those sides to fall into the gutters (see side elevation D). On the paltes I set on the side walls (see rear elevation C) are fastened the timbers forming the rafters and receiving the internal ceiling so as not to cover the transom K, the rectangular sashes alone opening. Dormers of this kind existed on the palace at Paris, on the structures of the beginning of the 14 th century, on the castlesof Montargis, Sully, Coucy, and Pierrefonds (beginning of 15 th century), and many other palaces and castles. Those of the middle and end of the 14 th century are very common.

Note 1.p.188. From a house of Beauvais of the 13 th century, now destroyed.

In certain provinces of France, like Brittany, Picardy and Normandy, there was a custom during the 14 th and 15 th centuries, of giving to certain country buildings and buildings of castles a low height, crowning them by enormous roofs, for although these buildings were single in width, they sometimes

had a clear width up to 32.8 and 36.0 ft.;now the roof being drawn as an equilateral triangle, it is understood that the ridge must rise much above the cornice. Those buildings in se section were then arranged in this manner (3);:-1, a cellar story A; 2, a ground story B; 3, a second story C, half mansard; 4, a story D in the middle of the roof and the attic; thas the windows of the second story C already were dormers and only formed a part of them. We have a very beautiful example of this sort of construction in the castle of Josselyn in Brittany, (4), whose construction dates from the last years of the 15 th century. There the ridge of the dormers is on a level with the ridge of the roof; their fronts are decorated by sculptures, monograms, devices and arms; the openings are wide, furnished with mullions and transom bars, high gables flanked by pinnacles. The balustrade is paleed on the edge of a gutter casting its water through a gargoyle between the dormers. In the apper mansard story the dormers form a kind of well lighted recesses, in which one could remain to work or to enjoy the view of the country. The picturesque appearance given by these great dormers to the facades of buildings led the constructors to give them increasing importance; they sometimes became the principal part of the decoration, about the end of the 15 th and the beginning of the 16 th centuries, as one can still see on the palace of justice of Rouen, where it seems as if the facades are only made for dormers, since their composition starts from the ground of the court. In more modest proportions beautiful dormers of the beginniug of the 16 th century are still seen at the mansion of Cluny at Paris, and the city hall of Compiegne; on houses of Tours, Bourges, Orleans and Caen; on the city hall of Saumur, etc. The dormers of the castle of Josselyn, like those of the palace of justice of Rouen, are actual gables maskiug roofs penetrating the principal roof at right angles. In this case they can serve to resist the thrust of the carpentry, when this is without tiebeams at its base, or at least they break this thrust on the eave walls at certain distances, and give those walls great stability by their weight.

Dormers of carpentry, small and modest during the 13 th and 14 th centuries, likewise assumeed much importance during the 15 th century; like dormers with stone fronts, they only appear in the architecture of the middle ages at the moment when roofs

cease to be flat, and at least are drawn at a slope of 45° degrees. Then they are set, not on the eave walls of those roofs, but on their rafters to light the attics. They are always well combined as carpentry and are graceful in form, contrary to what is practised today.

The oldest wooden dormers known to us, properly speaking, are only large attic openings to give air and light in attics, but that cannot receive glazed sash; they are cut in coarse woodwork and are covered by tiles, slates or lead. They existed on the burned roof of the cathedral of Chartres, that dated from the 13 th,century. Here (5) is their construction; two headers A formed a rectangular opening occupying two spaces between rafters. On the rafters B were set two triangles D rereceiving the front E on their ends, and small ties with rafters F. Strong oak planks were nailed on those rafters and connected them with the front; on these planks was placed the lead, which formed a collar on the front and at the sides, as indicated by the detail G. Other sheets of lead covered the front and sides, including their thickness. The timbers were 5.9 × 9.8 ins. and carefully cut.

However, one sees appear in the 14 th century carpentry dormers of very great dimensions, sometimes divided in two openings by a mullion. The roofs of the cathedral at Autun have retained some that date from the end of the 14 th century and are of quite beautiful form (6); the wood of those dormers always remains visible and is sheltered by a strongly projecting tile roof. These dormers were made to be closed below the lintel by shutter with glass and opening inside; the gable remains open.

The church of Notre Dame of Chalons-sur-Marne has retained on the hip of the apse a pretty dormer covered by lead with terminal and weathercock (7). One still sees on the great roofs of the cathedral of Rheims dormers, that date from the 15 th century, but which are now disfigured by numerous restorations. These dormers are crowned by terminals like that of Notre Dame of Chalons. Some houses of half timber work of the 15 th century, whose facades are not gables but eave walls, are surmounted by very beautiful dormers. In the work of MM. Verdier and Cattois on Arch. civ. et dom., we mention some, notably those of the hospital of Beaune and that of a house at Lisieux. The

The architects of the 15 th century have sometimes adopted for the construction of dormers of carpentry, an arrangement of stone dormers mentioned above at the castle of Josselyn, i.e., they were set on the top of the great wall and lighting a story under the roof, an attic.

We give (8) a dormer erected on this system, and that comes from a house of Gallardon. At A we present the elevation and at B the section. Here the wood is visible below the band C, that is covered by slates. The lead covers only the terminal and the ridge. The roofs and sides are also covered by slates. Glazed sashes close the openings.

If one consults the old painted and engraved views made of the castles and palaces of the middle ages, one sees that the dormers filled an important place in these habitations, since the roofs contained many lodgings. Sometimes as at the castle of Pierrefonds, dormers of stone or wood and combined with the crenelations of the inner gallery, were destined to light halls placed behind those external passages. Their fronts then rest on the wall of the gallery,the light penetrating their covering reaches the hall by an opening pierced in the great wall.

It is certain tha the architects of the middle ages,contrary to what is generally practised today, devoted minute care to the study of all parts of the roofs, both from the point of view of stability, and good construction, and of art. For them to properly crown an edifice was the important matter, a and they did not think that the part of the architect ceased at the top of the cornice. The composition of dormers must necessarily fix their attention, since these important parts of the roof are detached against the sky, and thus contribute to the monumental appearance of the edifices. Besides we must s state, that this tradition was maintained during the 16 th a and 17 th centuries; for many chateaus of the Renaissance from the time of Henry IV and of Louis XIII have retained dormers designed with care, often very richly decorated by sculptures and statues, occupying the greatest place in the arrangement of the facades.

LUNETTE. Circular Opening.

A round opening placed at the middle of a cross vault like a great boss,for the passage of pells.

MACHICOULIS. Machicolation.

Square or oblong openings made horizontally along the defensive gallery or a tower or curtain, allowing men to defend the foot by dropping stones or burning materials. Machicolations existed in the wooden galleries built on the ramparts en the first times of the middle ages and until the 13 th century. (Art. Hourd). But these galleries were frequently burned by the besiegers, and they were replaced about the end of the 13 th century by inside galleries of stone corbelled out at the tops of the walls and towers, and pierced by holes close together through which were dropped on the assailants materials of all kinds, boiling water, hot pitch, etc. We have seen in Art. Hourd, now already at the castle of Coucy, i.e., at the beginning of the 13 th century the projecting beams of the g galleries were replaced by stone corbels. Yet after that epoch were established actual stone machicolations at the tops of some edifices, notably on one of the dependances of the cathedral of Puy-en-Velay, an addition that dates back to the 12 th century. That beautiful building, known in the country by the name of the building with machicolations, merits very particular attention, for it is one of the most remarkable military structures that we possessed in France, an important and substantial defense placed over a great hall with pointed tunnel vault, a defense that can contain 200 men and cover with projectiles the entire south side of the cathedral, between that and the rock of Corneille. That was like an advanced work for the castle, which crowned that rock, stopping the assailants at the sole point at which it was approachable, and absolutely masking the cloister and its dependances. At the origin, i.e., in the 12 th century, the great hall that long served as the hall of the provincial state was covered directly on the tunnel vault by double slopes of tiles set in mortar. In the 13 th century this hall was surmounted by a defense, w whose plan we give here (1). This defense was reached only by a narrow passage communicating with the door A. Before the buttresses B open machicolations C; other machicolations D defend the face of the wall between these buttresser. Piers E are p placed on the buttresses behind the machicolations, and other piers F built on the wall toward the cloister bear plates on which rest the trusses, that support the covering which shelters

the entire area of the building. At the ends are gables.

The transverse section made on a b (2) indicates at A the great hall of the state, at B are the buttresses. One sees the arrangement of the machicolations, whose battlements C are borne on arches resting on the corbels. A parapet D protects the defenders from arrows shot from outside. Slots are pierced in the walls of the crenelles and not in the merlons, as indicated in the plan and section. By the arrangement of the piers a defense was entirely independent of the carpentry. The external face of the battlements is given in Fig. 3. The machicolations are solidly built by means of arches turned on corbelled courses. One notes the interesting construction of the great machicolations between the buttresses, whose twin arches are surmounted by a discharging arch that relieves the middle corbel. At each buttress the rafters of the carpentry project so as to shelter the small machicolations. That entire structre is made of fine cut stone and lava, and it seems to date from yesterday. Its external effect is striking. These machicolations in the form of large holes especially belong to the southern provinces, and they preceded by nearly a century the machicolations of the North, which consist of a series of square holes arranged between corbels. We shall see at once, m machicolations in form of long holes in the defenses of the 14 th century, belonging to the cathedral of Beziers.

The machicolations of the great hall of Puy are further not the only ones of that kind found in Auvergne. The church of Royat near Clermont is crowned by machicolations, whose style of construction merit study. Then the architects charged with directing military works did not believe that ugliness and c vulgarity of forms was one of the conditions imposed by a programme under a pretext of sacrificing all to utility. Because art entered for something into their composition, these defenses lost nothing of their strength; flexible and ready to satisfy every need and even to vindicate them, the artist knew how to please the eyes by the attentive and true study of the least details. Certainly in works intended for the defense of a place or a post, the art intervened to sculpture or paint, as with the Chinese, hideous monsters on the battlements, designed to terrorize the assailants, one can smile at its inspirations; but when on the contrary, art submits to all requ-

requirements of the defense, it knows how to give to the least details a beautiful form clearly indicating their purpose; w when it seeks nothing but the most reasonable and solid construction, one can admit that it is well to allow it to take its place. Now it is given to art alone to express by suitable forms all needs, even the most ordinary, and we shall see no inconvenience because in our modern defenses the external appearance corresponds to the reality.[1] To crown a gate today, a barrack or defensive work, by machicolations would be ridiculous; but it is entirely otherwise at least, to give these military works the appearance of a mansion, to surround them by Roman pilasters, to terminate them by cornices profiled a according to the rules of Vignola, and to enclose their openings by architraves borrowed from treatises on architecture f filled with the ideas of dealers in engravings. All the examples of the various parts of the architecture of the middle a ages, that we give in this work show well, that each of those parts exactly fulfils a function, and that one cannot confound a detail af a military edifice with a detail of a civil or religious structure. Each monument retains an appearance peculiar to itself, each detail accords with the part of the programme that required it, and the more the programme tends to i impose a certain form demanded by a definite and imperious need, the more the architecture gives to that form an accented character. We shall have the proof of this once more, if one is willing to follow us in our study of machicolations.

Note 1.p.200. How is it with our casemate barracks, that have the appearance of houses of pasteboadr? Such as they are, we admit that they resist perfectly the effect of bombs; but to see on the exterior their lean construction, one would not credit them with the robust qualities that they possess.

Let us see (4) the arrangement of the machicolations crowning the church of Royat. At A are seen the machicolations in section; they are presented in elevation at B. This construction belongs to the first half of the 13 th century; it consists of a series of arches borne on corbels. Between the buttresses of the edifice are counted four arches. The architect understood that the angles and still more the the fronts needed to be pr protected by machicolations, and has adopted an arrangement of corbels C that allow the merlons to follow their planes,

and that leaves to each angle a large square macnicolation. The detail of the corbels is traced in Fig. 5, the profile at A and elevation at C. One sees the taste of the artist appear here, for those corbels are carved in the happiest manner. B But if we approach the provinces of the North, the machicolations scarcely appear until the end of the 13 th century. The ease in obtaining wood and also the strong projections of the fortifications of those provinces permitted them long to retain the system of defensive galleries. For example, the defenses of Caracssonne, which were erected by Philip the Bold about 1285, nowhere present traces of macnicolations, although they already existed in the provinces of the Centre and South, and these defenses were established with a great luxury in d defensive precautions; but Carcassonne was then surrounded by vast forests, and its ramparts were built by architects from the North.

About the same epoch in Burgundy, where limestone is abundant, beautiful and solid, we see machicolations appear. They already exist on the summit of the tower of the castle of Mo- Montbard; but these macnicolations are not continuous, but form a sort of projecting watch turret on each front of that t tower, whose plan is a square terminated by three cut-off angles. These machicolations thus defend the fronts and not the angles. We present at A (6) the plan, at B the internal, and at C the external elevations; at D the section on a b, at E t the side elevation on c d, and at F the section on m n. Those machicolations are covered and present externally the appearance of a projecting merlon borne on corbels, pierced by a hole in the form of a quatrefoil. The sides and front of this little projecting bay are constructed of three slabs 3 ins. thick; the coping is made of two stones. The hole in the machicolation is nearly at the height of the sills of the crenelles, so that it was necessary to lift the projectiles, that one desired to drop on the assailants. As for the merlons placed between these machicolations, they are crowned by pinnacles, pierced by slots in the long fronts and fitted with iron hooks, as w well as the sides of the machicolations, intended for hanging wooden shutters. A perspective in Fig. 7 will illustrate the whole of that system of defense. This construction is made of fine materials, that time has not changed. The pinnacles alone

have been thrown down; we could only restore them from fragments.

It is clear that the assailants placed at C at the base of the tower (see the plan, Fig. 6) could scarcely be struck by projectiles falling from these amchicolations; but it must be stated that this tower is built on a precipice of rock, and that the besieged counted on the rebounding. Yet men did not delay to seek a system of continuous machicolations, that could defend the entire extent of the ramparts, and these were at their base arranged with a view of the effects produced by the fall of the projectiles, as that had already been attempted for the defensive galleries.(Art. Hourd). It was also desired for the machicolations to strike the projecting angles. But those improvements were introduced into the art of fortification of places and castles only about the middle of the 14 th century. There are seen machicolations of that epoch very well established on the summit of the tower of the castle of Beaucaire. The plan of that tower, or rather of that keep, gives this Fig. (8), presenting a projecting angle A t toward the exterior of the fortress.

Although this angle dominates the considerable precipice of rock and is solid, still it is crowned by the row of machicolations surrounding the work. In plan (9) the corbels of these machicolations are set askew to form two lines parallel to t the point as indicated by the sketch A. The angle then dominated by a crenelle perpendicular to its axis and by two triangular holes in the machicolations; it is defended. We present the perspective view of it at B. The profile C is made on the axis of an arch of the machicolation. One will note the projection d arranged beneath the corbels, and which is intended to prevent projectiles falling through the holes from rebounding on the rough surface, that would cause them to deviate from the vertical line of fall; nor the vertical line of drop was calculated with great care by the military constructors, and it always struck the batter, that caused these projectiles to describe a certain parabola because of their weight anf the height of the wall. If the assailant came to stay at the foot of the rampart, he could easily protect himself from projectiles falliug vertically by means of a shield covered by iron and padded with tow, but it was indeed more

difficult to provide against stones coming obliquely; besides, those shots prevented approaches. To ensure the effect of projectiles falling through the machicolations, the besieged took care to dress them. In long sieges and when stones were lacking, they dropped through the machicolations whatever came to hand, blocks of wood, tiles, boulders and rubble. But if the place were well provided, projectiles suitable for defense by the machicolations were made of heavy stones, spheres of regular diameter; only then could their effect be ensured.[1] Thus if one desires to study the machicolations, it is at the same time necessary to observe the inclination of the lower batter of the walls, for that slope is determined by the height of that wall, by the projection of the machicolations, and by the need for striking a certain point of the ditch, of the scarp or terrace. In the fortifications of the 14 th and the beginning of the 15 th centuries, the machicolations and slopes are combined together to produle a certain effect imposed by the needs of the defense. Let (10) at A be the section of the rampart with machicolations, the rampart being little elevated above the bottom of the ditch G; it is then necessary to prevent the assailant from approaching sufficiently to be able to place ladders, the slope forming a great angle with the vertical wall, and then the projectiles will be sent far from the point H (foot of the batter) and will roll to the bottom of the ditch in rebounding. The heavier the projectile, the more the parabola I K will approach the straight line and diverge from the point H. If the enemy reaches the point H, projectiles of moderate weight can strike him. If he fills part of the d ditch and reaches the point L, he will receive the projectile obliquely with all its force.

Note 1.p.208. It is not to be doubted that projectiles intended for machicolations were cut in advance and were spherical. We have found an enormous quantity of those stone balls in structures preceding the use of artillery, and what is still better proof, one frequently sees some, that have remained stuck in the holes of machicolations too narrow to allow t them to pass.

Assuming that the ramparts B are sufficiently high to not fear scaling, the batter will form with the vertical an angle more obtuse, and the projectile will fall obliquely near the

foot of the slope. Assuming again that the rampart is little elevated above the counterscarp of the ditch, but that this is deep (C), the batter will be so arranged that the projectile will sweep it for its entire height at a little distance. If the rampart is built on a precipice of rock (D), the batter will be traced so that the projectile will fall at the foot of the rock, in order to drive away the miners. That will cause it to be understood, the importance of having spherical projectiles of known weight for defending the foot of the ramparts by means of machicolations, according to the nature of the attack, and how the section of the batter should be traced according to the nature of the place. Now if we know today th that officers of engineers calculate with precision the angles of bastions and the sections of ramparts to obtain certain effects, we can be assured that in the 14 th century the military architects devoted no less care and calculation in drawing their machicolations, the copings of their battlements and all details of these constructions, happy proportions, and profiles of a beautiful character.

Still we have seen in Art. Hoard, that the wooden inner galleries with machicolations were covered. It was indeed necessary to shelter the defenders placed in these inner galleries, behind the battlements, from projectiles cast indirectly by the assailants; men then undertook to cover also the machicolations with stone, as they had covered the outer galleries by roofs of carpentry, but those permanently. The most remarkable machicolations of that kind, that exist in France are c certainly those of the castle of Pierrefonds; they date from 1400. We shall return to them immediately.

Before occupying ourselves with this sort of machicolations, it is necessary to speak of those of the ramparts of Avignon, erected about the middle of the 14 th century, and which present certain peculiarities worthy of attention, for example, the square returns on towers, the angle corbels, projecting machicolations, etc. The machicolations of the ramparts of Avignon having never been intended to be covered, and being surrounded by simple battlements, to avoid overthrow the constructors have given ao the corbels a sufficiently great number of courses to load the tails of each corbel. Thus (11) let A be the corner of a tower, then will be a diagonal corbel at B,

which according to the section c d will give the profile D w with C corbelled courses; the two corbels C will be slightly askew to obtain equal arches B C and C F, the corbels C and F will have only 5 courses (see profile E made on e f). In e elevation that angle will present the drawing G, which explains why the angle corbel B being longer than the others, takes another course at bottom. The arches of the machicolations a adjoining the corner penetrate that diagonal corbel. At g is represented in perspective the course g', at h the course h'; at i the course i', at l the course l'. These stones with tails loaded by the mass O (see sections D and E), cannot tip under the weight of the battlements. The flanking watch turrets of the towers being higher than the curtains, the internal gallery is stepped and the machicolations rise as indicated in Fig. L; each step m is pierced by its machicolation. (See profile P made on the line r h). One sees at the palace of the Popes at Avignon machicolations obtained by means of great arches resting on the buttresses. These machicolations produce long spaces through which one can drop not only stones but timbers flatwise (see Art. Architecture Militaire, Fig. 40); they had the inconvenience of not striking the fronts of those buttresses, thus leaving points accesseble to the assailants. This system was scarcely employed by military architetts of the provinces of the North; they adopted by preference the system of continuous machicolations. Indeed it is necessary always to seek in the works of northern architects the m most serious defenses; many fortifications of the South of F France and of Italy seem to be made rather to strike the eyes, than to oppose a formidable obstacle to the assailants, and in those countries the machicolations are frequently a decoration or crowning and not an efficient defense.

We have just stated, that the machicolations are not well protected unless they are covered like the outer galleries. Then let us examine the machicolations of the castle of Pierrefonds. These form a continuous series at the tops of the t towers and curtains, they were not only covered, but also surmounted by buttresses, that command the approaches afar. See (12) how were arranged those machicolations. At A we give the plan of a portion of the outer gallery of the towers taken at the level a. The holes of the machicolations are drawn at b.

At B is drawn the sections of the entire defense and at C is its external elevation. The gallery D with its machicolations is covered by the shed roof G. At regular distances the dormers E are placed on the walls of the galleries opposite the windows F and light the halls I. At K are the upper battlements. The tails of the courses of the corbels I extend deeply into the masonry, and are loaded by the great wall to prevent overturning. The lintels M are cut radially between the corbels as indicated by the elevation, the imposts O are then cut according to the perspective sketch O'; thus no chance of rupture exists in the construction. A recession of the face between the corbels at P leaves a projecting angle, that prevents arrows shot from below from rebounding and ascending into the gallery through holes of the machicolations. At the base of the towers and curtains, a pronounced batter causes the projectiles dropped through the holes to rebound, as indicated by Fig. 10. This was a serious defense, combined in a manner entirely remarkable, when the armies did not yet possess artillery, and when the galleries were sufficiently elevated above the ground, that their walls and roofs had nothing to fear from casting machines, like mangonels, stone-throwers and trebuchets. Without modifying in any manner this system, about the middle of the 15 th century men desired to give to the m machicolations a less severe external appearance; they were sometimes ornamented. For example, such are the machicolations placed over the gate of the beautiful castle of king Rene at Tarascon (13). At the end of the 15 th century the progress of artillery caused the rejection of this mode of defense, yet there were still represented machicolations on the summits of the towers and castles, at least by tradition.

Sometimes machicolations were established on the crossings of churches, when it was judged that they might be invested; thus on the apse of the cathedral of Beziers between the buttresses, and to defend the windows from scaling, there were constructed about the beginning of the 14 th century machicolations terminated by a parapet with open crenelles in the form of a balustrade. This monument was placed on the highest point of the city and attached to the fortifications, and was regarded as the citadel, and for all time it had been equipped with battlements. (Art. Creneau). At the rebuilding of that

church after the wars of the Albigenses, they merely conformed to a tradition. Here (14) is an external view of one of the machicolations of the chevet, at A is traced the section of the defense. Let us add that the windows are fitted with very close grilles, that present an obstacle sufficient to stop assailants vertically under the holes of the machicolations. Open cornices with great corbels, on projecting corbels are again a last trace of those machicolations, so common in the habitations of lords of the 14 th and 15 th centuries. To close, let us say that the holes of machicolations of the fortifications in the North of France have dimensions evidently according to regulations, they form squares that vary from 13.0 to 15.7 ins. side; thus the projectiles intended to pass through these holes could be taken to any strong place, which was an important point.

MACONNERIE. Masonry.

All construction into which enters stone, rubble, brick, m mortar or plaster. (Art. Construction).

MAIN-COURANTE. Hand-Rail.

Rail of a flight of stairs. (Art. Escalier).

MAISON. House. Dwelling.

It is necessary to distinguish city houses from country houses, but the latter should not be confused with manors. The true country house is that of the cultivator, the peasant, a family attached to the feudal lands. As for the city houses, those of the lords have a particular character. We class these as palaces or mansions.[1] It is true that up to the 12 th century the nobility rarely dwelt in the cities, and the customs of the conquerors of Gaul were long retained by their descendants.

Note 1.p.214. For mansions, see the end of Art. Maisons de Villes.

The habitations of the Gallo Romans could not be modified i immediately after the invasions of the 5 th and 6 th centuries. The new possessors of the territory apparently did not think of causing the erection of houses of a new form, they occupied the Roman villas; for living in the fields by preference rather

than in the cities, if they caused the erection of habitations by their cultivators or serfs, these houses necessarily retained the form consecrated by long custom.

In the art of architecture, the house is certainly what best characterizes the customs, tastes and the usages of a people; its arrangements and its plan is modified only after a long time, and however powerful the conquerors, their tyranny never went so far as to attempt to change the form of the habitations of the conquered people; on the contrary, it occurred t that the invaders yielded in what concerned the habitations to the customs of the vanquished, particularly if the latter were more civilized. Still the newcomers gradually introduced into those customs modifications, that belonged to their character and traditions; they established a compromise between the two principles of existence, and after a century or two had passed, the habitation left by the first possessor of the soil was slowly transformed. However it is unnecessary to believe, that those transformations were such, as not to leave remaining very apparent traces of the habits and consequently of the primitive structure. From the first centuries of the middle ages, i.e., during the Carlovingian epoch, the country dwelling of the French took a character of defense for the c city house, occupying a narrower area because of necessity a and enclosing those cities by walls, these must necessarily abandon in many cases the extended arrangement of the ground story to superpose stories in order to find in height the space lacking in area. If the Romans did not employ wood in profusion, when they constructed houses for themselves, it is c certain that the people of Gaul never ceased to use that material; perhaps during the Roman rule they gave greater importance to masonry structures; but under the influence of invasions from the North, they certainly renewed construction in wood without difficulty. Indeed the art of carpentry, the exclusive use of wood construction only belongs to the Indo-Germanic races. Wood enriched by paintings plays an important p part in the construction of the Merovingian epoch, and the f frequent conflagrations, that destroyed entire cities during the first centuries of the middle ages sufficiently proved t the almost exclusive use of carpentry in private structures.

Of these habitations preceding the 11 th century, there re-

remains nothing today; then one can only form an idea of them by collecting laconic statements given by the writers, vignettes of manuscripts, very imperfect, and some reliefs. But however vague these documents, they are less conclusive on one important point, to know that the houses of the first times of the middle ages were made of wood, that those structures of wood were a mixture of carpentry and piles of timbers connected at the angles; and this point merits our entire attention. Let us explain. There are two modes of constructing in exclusively employing wood; one can either pile on each other the squared trunks of trees by notching them together at the square angles, or one can by more or less ingenious combinations, sometimes using the wood as a rigid support, sometimes as a tie, sometimes to relieve, and sometimes as a simple filling, obtain timber frames of extreme stability, very light and allowing the erection of structures of great heights. The first of these methods does not require on the part of constructors great efforts of intelligence; we see it followed also among slave peoples, while the second belongs only to the pure white races; we see it practised at the origin among all the peoples that descended from the northern plateaus of India, among scandinavians, Franks and Normans. The data that one can collect on the habitations of the Merovingian and Carlovingian epochs allow us to see some traces of the method of construction in wood by piles, and sufficiently developed wooden construction in the assembled carpentry of the Gallo-Roman traditions.

At the epoch when we can commence to collect fragments of French habitations, i.e., at the end of the 11 th century, we prove still the influence of those various influences, on the one hand belonging to the Latin civilization, on the other to the Indo-Germanic traditions more or less pure. In the art of construction of houses in France in the middle ages were produced singular oscillations, that depend on the predominance of the Gaulish or the Germanic character ower the remains of the Latin civilization, or of this over local traditions, and over the tastes of the invaders from beyond the Rhine.

Thus in the 12 th century during the greatest development of the Cluniac and Cistercian monastic institution, in the c cities in which the influence of our abbeys dominates, the

cities in which the influence of our abbeys dominates, the h house is constructed of masonry, the Roman tradition resists the influence of the North, while in the cities more independent or more directly placed under the royal power, the wooden house daily tends to replace the stone house. The greater or lesser abundance of one of these two materials, the proximity of wood or stone to the centres of population, did not have a decisivi influence upon the system of construction adopted.

In order not to exceed the limits of this work, we must restrict ourselves to mentioning this fact, whose explanations we shall endeavor to give elsewhere.

MAISONS DES VILLES. City Houses.

The scarcity of ground in cities or walled market towns compelled constructors to build several stories above the ground story. If at Rome in antiquity the houses possessed a great number of supeeposed stories, it does not appear that this method was followed in the provincial cities. At Pompeii the h houses have only a ground story with very few exceptions, the antique paintings rarely indicate habitations composed of several stories. On the contrary from the Merovingian epoch urban houses possess one or more stories above the ground story; authors often mention their stories, and the sculptured or painted representations rather show us the form of towers or of elevated pavilions, rather than of adjacent houses. Gregory of Tours mentions houses of several stories; he says that "Priscus had ordered at the beginning of his episcopate, that the buildings of the episcopal house should be made higher." [1] Duke Beppolen being at table in the house of three stories, suddenly the floor fell." [2]

Note 1.p.218. Hist. de France. Book IV. Chap. 38.

Note 2.p.218. The same. Book VIII. Chap. 42.

The Merovingian houses, numerous traces of which remain in the North of France, usually consist of a cellar of masonry not vaulted, surrounded by wooden structures, their perimeter is small and the lodgings must necessarily be superposed. According to that programme appear to have been constructed the houses, copies of which we give here. (1, 2). Fig. 1 evidently indicates a wooden structure; but it must be stated that it is found on a capital of the primitive church of Vezelay preceding the establishment of the commune; while in the same

locality are still seen numerous fragments of stone houses from the beginning of the 12 th century.[1] Indeed Aug. Thierry in his Lettres sur l'histoire de France,[2] in recounting the phases of the establishment of the commune of Vezelay, mentions that tendency of the emancipated citizens to surround themselves by external signs of their enfranchisement. "They built a around their houses battlemented walls, each according to his wealth. One of the most important among them, named Simon, la laid the foundations of a great square tower." Fig. 2 presents a peculiarity that should not be omitted, an external stairs; indeed we see that these external stairs or great flights of steps play an important part in the habitations of the 11 th and 12 th centuries. The tapestry of Bayeux shows us Harold and his companions banqueting in a house at the time of their passage in Normandy. The banquet hall is situated in the second story over a great story formed of arches; the flight of steps descends from that upper hall to the shore of the sea; that ground story is evidently built of masonry, while the second story appears to be of carpentry.

Note 1.p.217. Fig. 1 reproduces a house carved on a capital of the church of Vezelay, preceding the rebuilding at the beginning of the 12 th century. Fig. 2 gives a house copied from a capital of the cloister of Moissac (12 th century).

Note 2.p.217. Letter 22.

One again finds that arrangement of external stairs in Greek manuscripts of the 8 th century (Art. Perron), and we see it perpetuated till the 16 th century. Note this important fact; that in France during the first period of the middle ages and until the 12 th century, it seems that in private habitations have been maintained the traditions of Gallo-Roman antiquity for the ground story, and that for the upper stories have been adopted the customs introduced by the people that came from the North. Indeed it might be after the invasion, that the new conquerors retained a good number of those Gallo-Roman city or country habitations, and that on the ground stories composing them, they had caused to be erected in carpentry halls a and services that they needed. Thus since then had been adopted a system of construction resulting from the two methods, grafted one on the other by the habits of the two civilizations, or rather of two different races. In masonry the Gallo-

Roman influence makes itself felt very late, while the structure of wood from the origin had a character, that evidently belongs to the races from the north, and that nowise recalls the art of carpentry of the Romans. That superposition of two systems of construction springs from two opposed civilizations, and only with great difficulty succeeded in forming a complete entirety, and until the end of the 12 th century, one recognizes that the mixture is not effected.

The lay school of the 13 th century succeeded in making this combination, because it entirely abandoned Roman traditions, and only at that epoch did these private structures assume a character truly French and homogeneous, adopting logical methods according to the materials used in the work. It suffices to look at the western manuscripts of the 9 th, 10 th and 11 th centuries, at some ivory carvings of that epoch, and even at the tapestry of Bayeux, to prove the influence of the traditions of Gallo-Roman construction in the masonry of the ground stories of the habitations, and that of Indo-Germanic wooden structures on the upper parts of palaces and houses, while the churches always affected the form of the Latin basilica or that of the Byzantine religious edifice.

Evidently if the lords and citizens allowed the monks to a arrange the architecture of their monasteries at their pleasure (and this was Latin by tradition), they exerted an influence on constructors charged with erecting their habitations, a and in spite of the antipathy existing between the caste of the conquerors from beyond the Rhine and the old Gauls that had become Latins, it seemed that at the contact of the purest races, the Gallo-Roman recalled its origin and gradually resumed the native tastes, reacting against the Roman arts so long continued, and in its habitations was pleased to compose an art of its own. Thus already in the 12 th century, t the houses of the citizens nowise resembled the residence buildings of the monasteries; it is a different art with other methods of construction; civil architecture is formed with the establishment of the communes, it assumes its independent charm just like the feudal castle, which on its part differs mo-more and more from the Roman villa, to the traditions of which the abbeys alone remain faithful. It is always interesting to see how among peoples left to their own instincts, the arts

and especially architecture reflect the tendencies of their minds.

In the 12 th century monastic architecture has reached its climax and advances no farther. S. Bernard endeavored to restore to it the meaning that it lost daily, by imposing on it simplicity as a primary condition; but after him that puritan art, that he claimed to give as a type of religious establishments, was swept away in the common torrent. On the contrary, military and domestic architecture developed with prodigious activity; the old remains of Roman arts were decidedly set aside, and the citizens, like the lords, desired to have a flexible art, that lent itself to all requirements of the changing habits of a people. As soon as the power of the religious establishments weakened, the municipal anf even the political spirit appeared, and the century was not yet ended, when all works of art and industry were in the hands of those citizens, who fifty years earlier, must have asked from the monasteries the plan of a palace, even of the ironwork of the doors.

It would be of the highest interest to have again today some of those city houses of the 11 th century, i.e., of the ep-epoch when the Gallo-Roman traditions were still quite entire, and with the primitive Gaulish combined so strongly with the architectural forms imported by the people from the north of Germany and by the Normans. We only have from those times very imperfect documents afforded by the manuscripts; however they allow us to prove the presence of those wooden structures, that have an analogy only with some old carpentry structures of Denmark, Tyrol and Switzerland. [1]

Note 1.p.219. But it must be stated that the Slavic element has profoundly modified these structures of the Tyrol; yet o one still recognizes there the traces of that Indo-Germanic carpentry characterized in the monmuents an manuscripts.

The appearance of the French city house of the end of the 11 th century and beginning of the 12 th does not recall the Roman house. The outlook is no longer on the internal courts, as in the antique house, but on the public street, and if the court still exists, it is reserved for merely domestic services. From the street one directly enters the principal hall, nearly always raised above the ground by several steps. If the

habitation has some importance, that first hall in which persons are received and eat is doubled by a rear room, which then serves as a kitchen, or as a dining room on ordinary days; the chambers are situated in the second story. But a drawn plan will avoid too lengthy explanations. Here then (3) is the plan of one of those houses of the beginning of the 12 th century.[1] From the street one ascends to the hall A by the bent flight of steps [2] presenting a first landing with a bench, and then a second landing enclosed before the entrance door, which is solid.

Note 1.p.220. After plans collected especially in Burgundy, Nivernois and upper Champagne.

Note 2.p.220. This arrangement is common in the provinces where stone is abundant, as in Burgundy and upper Champagne; it is well understood to have been adopted, when the houses belonging to private men had no need of shops on the street. Remains of those houses with stairway and enclosed landing a are to be seen at Vezelay and at Montreale. We have also been able to recognize these arrangements in houses at Montbar, S Semur, Chatillon-sur-Seine, Arc-en-Barrois, Chateau-Villain and Joinville. There still exist ground stories of this kind perfectly preserved in certain Italian cities, and particularly at Viterbo. (See Architecture civile et domestique of MM. Verdier et Cattois).

This second landing is either supported by corbelling or by a little column at the outer angle, the underside of the landing so suspended, serves for a shelter for the descent to the cellar. These are generally spacious, well built and well ventilated, with central columns and transverse arches. Even sometimes there are two stories of cellars, particularly in provinces with vineyards. Beside the entrance doorway, that is solid and heavily ironed, is a little opening for recognizing persons that knock at the door. From that first hall, which is usually lighted only by a window looking outside and by t the doorway, when the weather is fine,[3] one enters a lobby B ending at the winding stairs leading to the second story, and beneath which one passes into the little internal court D, s sometimes common to several houses and possessinm a wella From this court is lighted the rear room C that serves as kitchen for the family. In the second story the arrangemen is the

same; the front room serves as bedroom for the family, the r rear room being reserved for the servants. But this second s story is often built of wood.[4] Its wide window occupies more than half the space, and the whole is covered by a projecting roof, for the building is double at that epoch and rarely presents its gable to the street. The half timber construction of the front of the upper storw is made of large timbers, and rests on very strong beams,that on the other hand lie on the division walls, and is plastered between the timbers; on the plaster are traces of drawings made with a point. The underside of the projection of the roof and the half timber work itself are painted in striking colors, yelloy and black, white and brown or red, red and black.[1] We give below the plan and view of the facade of that Romanesque house.

Note 3.p.220. The custom of leaving open the doorways of ground stories in peaceful times, and when the temperature was not too cold, is an ancient habit continued very late. The doorway was then simply covered by a portiere. Vignettes of manuscripts always indicate that kind of closure.

Note 4.p.220. Having found a number of those ground stories of houses of the 12 th century surmounted by modern stories in masonry, we have been induced to think that the second stories originally were lightly built. Then by examining the t tops of the division walls that alone remained in these structures, we have been able to prove the traces of half timber construction of the front corbelled out flush with this sort of buttress built on the extension of the party walls.

Note 1.p.222. We have found traces of those paintings on wood removed and replaced in structures of the 14 th and 15 th centuries, particularly on the rafters recut.

The internal arrangementr of the Romanesque house were sensibly different from those of the Gallo-Roman and Merovingian houses; indeed one still finds in the latter the separation of the apartment of the women, while the common life is indicated in the house of the 11 th century. Gregory of Tours also mentions the women's apartment; he says that"Septimina was sent into the domain of Marlheim to turn the mill and prepare each day the flour required for the food of the women gathered in the women's apartment." [2] In the Romanesque house of the 12 th century the family collected around the same hearth. In the

ground story the large room is the shop, if the owner is a m merchant; then the hall is in the second story. This hall serves as a bedroom, a gathering place; it is large and contains the bad of the father, mother and the children of small age. The apprentices and servants sleep in the garrets over the s second story. Then nearly always the kitchen is separated from the principal building by a little court; a gallery permits one to reach it under cover, a passage containing the straight stairs flanks the shop and affords entrance directly from the street into the hall of the second story. From that hall one likewise passes by a gallery to the story over the kitchen. According to this system are erected the houses of the city of Cluny, which date from the 12 th century.[1] We give (4) the plan of one of them.

Note 2.p.222. Hist. France. Book IX. Chapter 38.

Note 1.p.223. See Architecture civ. et dom. of MM.Verdier and Cattois.

The ground story A shows the passage with the straight stairs at C, the shop at D, the open portico at E, court at F, the ketchen at H with its great fireplace I. A well at g. The second story is drawn at B and shows the arreval of the stairs at K, the hall at L, open or glazed gallery at N, with a narrow stairs to ascend to the garrets, and a chamber at O. The general section through this house on a b is drawn in Fig. 5 at A, and a street elevation of the facade at B. This facade is still preserved today up to the level C, the story of the garrets alone having been destroyed; as for the later buildings, these scarcely remain any traces. The houses of the 12 th century of the city of Cluny are adjoining, i.e., are separated by party walls common to two properties, and although that c custom may be common in most French cities, there are certain localities, particularly in Burgundy, where the houses of the 12 th and 13 th centuries are separated by narrow passages, and consequently each has its independent side walls. One can recognize that this custoo likewise exists in most of the little walled cities, built at one time at the end of the 13 th century under the rule of Edward I in Guienne. But the regulations in force concerning the location of houses in the cities of France in the middle ages, their projections on the p public street, the manner of lighting, the discharge of water,

varied infinitely, each lord having established a particular custom on the territory subject to his jurisdiction. It also occurred that two houses adjoined with an intermediate party wall, a single roof with two eaves on two lateral streets.

One still sees in the little city of Montreale some houses built after this system, and one among others is near the gate on the side toward Avallon, which has been very well preserved. Fig. 6 reproduces the plan. That double house appears to date from the first years of the 13 th century.

At A are the entrances, flights of steps and stone benches; at B are the steps down to the cellars on the public street according to Burgundian customs, at C C′ are the halls of the ground story. At D are two little courts covered by hip roofs of wood only rising over the ground story. The stair hall is common, though its flights are separate. From the hall C one ascends to the second by taking the landing E and to the hall C′ by taking the landing F; thus in the upper story the door of the stairs in the house C is at G, and that of the house C′ at H. At I is a common well. On the street, this double h house presents the facade (7). The front buttresses with their corbels support a balcony in the second story, and the projection of the gable roof with a common gable, so that the t two flights of steps, the two descents to the cellars and the two balconies are sheltered. Behind these habitations are planted little gardens reached by the narrow passages. We cannot state whether these gardens were common to several houses or belonged only to some one of them, for the enclosures of these grounds have long since been overthrown; they extend to the a ancient rampart.

The isolating passages between the houses, whether these w were single or double, necessarily led the architects to build eave walls next the passages and gables on the street. Those passages are termed "endronnes" in the Gascon language, and s sometimes existed when the houses formed a continuous portico or covered passage along the street, an arrangement very common in small French and English walled cities built in the 13 th and 14 th centurieson the banks of the Garonne, Dordogne and Lot, and in the southern provinces.[1] One perfectly understands, that if it was necessary to leave passages between the properties, two lots were united to profit by the land of one

passage. Of two houses, two areas really made but one, with a separating wall in the axis of the gable. However this method is rarely employed.

Note 1.p.225. Among the little walled cities built at one spurt from 1260 to 1330, we shall cite those of Aigues-Mortes, Carcassonne, (lower city), Libourne, Villeneuve d'Agen, Villefranche-de-Rouergue, Montflanquin, Valence, Castillones, Sauveterre, Puyguilhem, La Sauvetat, Villereal in Agenais, Villefranche-de-Belves, La Linde, Beaumont, Domme, Sainte-Foy, Villefranche-de-Longchapt, Molieres and Montpazier, in lower Perigord; Mont-Segur, Belin, Cadillac, S. Osbert on Creon, in the suburbs of Bordeaux. (See Articles on l'Architecture civile du moyen age, by MM Felix de Verneilh and Victor Petit; Annales archaeologiques; Vols. VI, X, XI, XII). In the North of France, we will cite also the cities of Villeneuve-le-Roi, Villeneuve-l'Archeveque; all those little cities present regular plans laid out with a cord, with places, markets, churches, fountains and ramparts, houses with or without covered alleys, but on equal lont. We know that these facts derange somewhat the theories of the irregularity and the systematic disorder, that are attached to the civil structures of the middle ages; but we can only invite archaeologists to visit these localities, if they desire to obtain an idea of a little city of the 13 th century, built on a fixed plan within a very brief space of time. As M. de Verneilh said so well:- "In the second half of the 13 th century and in a very limited region of France, in Guienne and in Languedoc, perhaps fifty cities were founded without our historians having given the least attention to that great work of civilization and of progress. At least twenty of those little cities, the most recent and most perfect, are due to the English domination, and the histories of Sismondi and of Guizot do not mention this benefit, always real, t though dating back six centuries. If instead of founding so many cities, Edward I had destroyed a single one by violence, all our books would have still reckoned with that armed act. But the history of the middle ages is made thus." Let us add that these precious data collected by one of our most learned French archaeologists, do not appear to be consulted by M. Champollion-Figeac, who enlarges at length on the urban structures of the middle ages in his treatise on Droits et Usages,

encroaching on the matter of architecture without having had leisure to visit some of these civil structures, and asks us where we found the plans of Aigues-mortes, Villeneuve-le-Roi, Sainte Foy and Montpazier? As if the execution corresponded t to the projects! Who also demands of us to prove the antiquity of the houses of the city of Cluny. But could we not with much more reason require him to demonstrate the authenticity of the texts, that he takes the trouble to transcribe? Those cities are still standing and are inhabited, and in some days anyone can see them with their straight streets and the remains of their ramparts, their squares and their churches; as for the projects of their location, it would doubtless be interesting to recover them, although that discovery could add nothing of importance to the fact of the existence of those c cities, that for six centuries have not ceased to be inhabided.

The alleys between the houses sometimes have only the width of a channel stone, as one can yet see in the city of Montpazier, whose general plan is one of such perfect regularity a and arrangement(Art. Alignement, Fig. 1), but then these houses have two facades, one on the street of 32.8 ft. width, the rear one on an alley about 9.8 ft.[1] We shall soon return to these houses of the end of the 13 th century.

Note 1.p.227. One will see that this custom is retained in London.

We have given a house of the city of Cluny that dates from the 12 th century; in our Art. Construction, Figs. 115, 116, 117 and 118, are seen the elevations, plans and sections of a facade of a house of the same city, built about the middle of the 13 th century. The windows are already longer, the stories are higher, the stone construction is more important and the appearance more elegant. En some walled cities were erected in the 13 th century houses with several stories, whose facades were entirely built od stone. On the square of the c city of S. Antonin, that possesses such a beautiful municipal house of the 12 th century (Art. Hotel de Ville), one sees quite a large number of houses of the 13 th century with a monumental appearance.[1] Those houses are spacious and deep, possessing facades sufficiently extended and remarkably constructed. The ground story is occupied by stores or shops, the second and third stories being occupied next the street by a

a great hall in front with a stairs and little room attached and looking out on an alley as at Montpazier. Here (8) is the facade of one of those houses fronting on the square of the c city.

Note 1.p.228. S. Louis purchased from the count of Toulouse the city of S. Antonin for 1500 livres Tournois ($315). The house that we give is a little later than the time of that p purchase.

The arches of the ground story served as places for sales on market days, as still practised in many localities. Then portieres were suspended beneath the arches to shelter sellers and buyers. The large halls in the second and third stories are fully lighted by continuous arcades, that in the interior form windows separated by narrow piers. At the top of the house beneath the roof is the attic occupied by servants, and where provisions were stored. One will note that the piers of the windows at the height of the springings have rings of iron with crockets. Those rings were intended to receive poles to which were fastened awnings. That custom is continued in the south of France, Italy and Spain. Fig. 9 reproduces the arrangement of these awnings.

At A is one of the ring crockets fixed in the masonry. The awnings were divided in bays, as well as the poles that fitted into each other. (See detail B). Struts C raised the bottom of the cloth, whose movement and inclination were maintained by crossed cords passing underneath, and fixed by rings to t the crockets D. A wide gathered fall fell in front, as much to stop the rays of the sun as to give weight to the lower p part of the awning, and thus to comple the struts C to remain inclined.

The little city of Cordes between S. Antonin and Gouillac h has retained nearly all its houses that date from the 12 th and 13 th centuries, and approximate by their architectural style and internal arrangement to that just described. But those cities on the banks of the Garonne, Lot and Aveyron, were deeply permeated by the communal spirit, or rather had never ab abandoned the municipal traditions of the Gallo-Roman epoch; most had retained the remains of private habitations, that i indicate a very developed local administration, great internal prosperity and habits of comfort and even luxury that dis-

disappeared after the religious wars of the 16 th century. O Our epoch allows itself freely to go wit the current of certain prejudices, which flatter selflove and dispense with studying properly certain arduous questions, because they require time and research. How many times has it not been written, for example, that the houses of the middle ages are only poor hotels, gloomy and small, dark and finally uninhabitable? 1 Certainly the old houses of S. Antonin, Cordes, S. Yriex, Montpazier, Toulouse, Perigueux, Alby, Mont-Ferrand, Cluny, Provins, Bourges, Laon, Beauvais, Rheims, Soissons, Dol, Caen, C Chartres, Dreux, Angers, etc., are only small edifices, if c compared to our modern mansions of Paris, Lyons or Rouen, but it should not be forgotten that most of those old houses still standing, exist only in cities singularly declined, that in cities of the second or third rank, now abandoned but then w rich and prosperous, although they were of little importance if compared to the great centres of population of the same e epoch, that those old houses, if placed parallel to those puilt today in the same localities, are incomparably better constructed, better understood and with an appearance less poor, that they indicate a social state more advanced and more solidly established, a prosperity less fleeting and stronger municipal institutions. It is evident that by establishing a parallel between one of those houses of the little city of Cordes and the mansion of M --- at Paris, a free field would be opened to jesting; but let us compare an old house of S. Antonin to one of those built today in the same locality; compare the mansion of M -- with a mansion of Sens or that of de la Tremoille, mansion S. Pol or that of Cluny, or even the house of Jacques Coeur at Bourges, that exists nearly entire, on which side will be the laughers?

Note 1.p.230. See the work of M. Champollion-Figeac, Droits et Usages, already cited. If a man of profound erudition shows those prejudices, one cannot be surprised to see them extend among the common people.

We do not desire to make here a social nor even a political criticism; we shall speak of art. Now when art is concerned, it is a strange illusion to confound the civilized condition with the intellectual development. If a society be perfectly policed, if habits of comfort be disseminated in the lower

classes of the society, that does not state that its intelligence is developed; particularly that does not cause the life to be diffused in all branches of the social body. If in the 12 th or during the 13 th and 14 th centuries great edifices were built, and if artists abounded in Paris, Rouen, Lyons, R Rheims, Chartres, Bourges, Tours and Toulouse; in the last l little city, in the smallest village of France would be found an art also relatively elevated; is that so today? We build magnificent palaces at Paris, Lyons or Marseilles; but wha is done in the chief places of a canton, in villages? Poor s shaky and badly conceived structures, hideous in appearance although they affect a certain appearance of luxury; inconvenient houses, scarcely sheltered, concealing the egnorance of the contractor or the stinginess of the owned under coatings that every winter causes to fall. Into those weak buildings art not only does not enter, but good sense and reason seem to be exoluted. A shred of puerile vanity alone appears on the symmetrical facade or in the interiors with their poor luxury. We marvel to see in a little antique city like Pompeii, mean houses built of brick covered by stucco still present examples of delicate art; but we possessed in the middle ages the same privilege of placing art in everything. The houses of Pompeii would scarcely be comfortable for us, people of the 19 th century, those of the 13 th century in France are hardly more so; what does that matter in the question of art? The houses of Pompeii charm us because they are indeed the dwellings of the inhabitants of Campania; those of Cluny or of Cordes have the same qualities. But what will be ours for the people that will see them six centuries hence, if any remain? We admit that c comfort is the master today; then let us be consistent.

Is it comfortable to erect at Marseilles houses on the model of those of Paris, or even to construct facades exposed to the north similar to those open to the south? It is comfortable to light the rooms, small or great, by means of windows of uniform dimensions, to have narrow window piers for great halls and wide ones for cabinets? Porticos on the house, that allow sun or rain to enter for the entire width of their pavement, are those comfortable? It is comfortable that this multiplied division into rooms of an area of small extent, which causes life in the inteeior to be spent in opening and closing

doors, and to not know where to place the most indispensable furniture? And those storiesof less than 9.8 ft. in height beneath the ceiling, are they healthful and comfortable? Those thin walls, those zinc roofs that subject interiors to all variations of temperature, that absence of projections on facades, that leaves the openings exposed all day to the sun, are those comfortable things? Let us go to the country, where it is much worse! The little white house with walls as thin as pasteboard, roofs covered by sheets of zinc, windows closing badly, damp ground stories, floors and stairs that squeak, kitchens diffusing a nauseous odor in the interior, but which externally appoear as a beautiful square pavilion, gleaming in the sun; is that habitation comfortable? The modern chateau with its little towers, ornamented roofs, facings of brick or stone, that pretend to imitate old construction; is this chateau comfortable? Not at all. All that is show; the tower s are fastened by iron; the complicated roofs are covered economically, but have open crestings of zinc, that allow the water to leak into the interior; the thin walls crack; the floors are too weak for their spans and deflect. The discharge f for water is insufficient; the fireplaces smoke because the hearths are wide, as proper in a chateau, and the flues are small because they pass in thin walls. Everywhere overhangs cause cracks because large rooms are required in the ground story, and the upper stories are infinitely divided by partitions. Fireplaces rest on the middle of floors. We should never end, if we desired to enumerate all the more or less secret wretchedness of the modern chateau; defects revealed in time to others by some lawsuit brought against the complaisant architect, who has on the whole only done what was required of him. Besides, had he refused, would not ten others have b been found?

The habitations of the middle ages were made for the habits of those that erected them; further, they always wisely and simply constructed. Every need is indicated by a particular arrangement; the door is not made to please the eyes of the passer, but for him that enters the house. The window is not arranged with symme rical art, but it lights the room it is designed to light, and it has dimensions suited to that room. The stairs is not concealed but visible. The facade is shelt-

sheltered if necessary. Sculpture is rare, but the floors are good and solid, and the walls have sufficient thickness. In t the southern provinces the windows are small, in those of the north, they are numerous and large. Besides for the house of the citizen, the programme varies little. Always a hall in ea each story with internal stairs, or more frequently at the r rear with a little court. It is admitted that this is not comfortable for us; but that arrangement suited the habits of t the time, when even in the castles the family, i.e., the kinsmen and servants gathered in one room around the master. The programme being given, the architects fully satisfied it, which allows us to assume that they would have equally fulfilled any other programme, even those of today.

If in a city of the North, commercial and populous, we seek houses built on a programme similar to that causing the erection of those of S. Antonin, Cordes and Sarlat, dating from 1230 to 1300, we find some of them at Beauvais, Soissons and Amiens, much mutilated indeed, but which still show their system of construction. There is always the large hall in each story next the street; but in the cities of the North civil architecture is larger and more monumental. The houses manifest the spirit of the communes that have reconquered their prilileges. For example, let us examine this house that one still sees in beautiful fragments in Rue S. Martin at Amiens, and which recalls by its style the houses of Beauvais and Soissons of the same epoch (9 bis); it dates from 1230 to 1240 like that of S. Antonin. But there is a certain magisteroal air in that architecture, which gives it a marked superiority over those of the cities of the South. We have restored the gable of the ground story from other fragments of the same time and the same provinces, those that have been destroyed in the house on Rue S. Martin of Amiens.[1]

Note 1.p.233. There still exist beneath this house two stories of very fine cellars.

This marked difference of style is more striking still, when one takes a parallel between the houses built in the North, a and those in great part constructed of brick in certain cities of the South. Here (10) is a house of Caussade; it is contemporaneous with that of S. Antonin and that of Amiens, and dates from the middle of the 13 th century. The bases of the piers

of the ground story, the little columns of the windows, the b bands of the imposts alone are of hard stone from Caylus; t the rest of the construction is of brick.[2] In plan that house gives in the second and third stories a large hall nearly square with fireplaces, a stairs and a rear cabinet lighted from a garden. The fourth story is divided by a partition and forms two rooms. One still feels in that habitation the influence of the little private fortress; that was a remainder of those traditions of southern municipalities during the wars of the Albigenses.[1] Let us then take in the Northa house a little later, from 1240 to about 1250; let us seek one of the l largest and richest of that epoch; we shall go to Rheims and examine the house of the musicians, so called, situated in Rue du Tambour. That house has a much mutilated ground story, but has preserved intact its second story on the public street. T The roof rose above in mansards, no more traces of which are to be found under the modern roof.

Note 2.p.233. This house belongs to M. de Moleville, who w was willing to promise me neither to sell nor destroy the The shops of the lower story were closed and the windows of the second story were changed in the 15 th century, but the plan and the form of the primitive windows have been perfectly recovered. Those of the two upper stories have been preserved.

Note 1.p.236. In the work of MM. Verdier and Cattois, see some houses of the southern provinces, notably that of the Veneur, at Cordes. There are seen on the facade of the house of Caussade given here, rings fixed to the jambs of the windows to hold rods and awnings as protections from the sun.

The facade of this house possesses four high and wide windows in the piers; those niches are decorated by seated figures of musicians, larger than nature; beginning at the felt t the first musician plays on the drum and a sort of clarinet; the second plays the bagpipe, the third in the middle holds a falcon on his fist; the fourth plays the harp and the fifth the violin; the last is crowned by a chaplet of flowers. Here (11) is a bay of the facade. Of the shops of the ground story indicated in our Fig., there remain only the small arches and one of the piers. A wide carriage entrance opens at the opposite end into a court formerly surrounded by buildings of the same epoch, but of these only fragments are found. The build-

building on the street is of single depth, and it seems that it was divided into two nearly equal rooms. The stairs was in the buildings on the court.

This house perhaps belonged to the confraternity of musicians of Rheims, which in the 13 th century enjoyed a certain reputation, not only in Champagne but also in the entire north. As may be judged by examination of our Fig., the construction is simple and the ornamentation is rich. The figures are in the best style of Champagne.[2]

Note 2.p.236. Several times already has there been a question of the demolition of this beautiful house, the most interesting of the civil edifeces of Rheims. Awaiting that demolition, one of the owners (for the facade belongs to two private citizens) took care to have his facade painted every two or three years, including the statues. If this house must be destroyed, it would be much desired, that the facade should be rebuilt in Rheims itself; certainly the small sacrifice that the city would then impose on itself would be very largely recompensed by the interest presented by the preservation of this work of art.

The provinces had for their private buildings different schools of art as for their churches and their public establishments. The house of Burgundy in the 13 th century did not resemble a house of Aquitaine, Ile-de-France or Normandy. Thus for example, we find only in Burgundy that sort of house, whose screw stairs is placed in the front wall next the street and serving as a vestibule to the ground story. At Avallon a and Flavigny, in the little city of Semur in Auxois and even at Dijon, are still seen remains of houses, that present in plan the arrangement shown here (12). At the middle of the facade is placed the stairs A, partly corbelled out over the entrance doorway B; at the left or right, according as the stairs turn, is the door C that gives entrance to the first room D, from which one enters the second E and then the third F; and thus in each story. From the common room E, one enters a court or a little garden G. As a facade on the public street, this house presen s the elevation (13). The entrance door B is sheltered by the projection of the stairs, whose enclosure is placed on the ends of the steps corbelled out before the facade; an entrance O to the cellar is placed beneath the sill

of one of the windows of the ground story; the cellars in Burgundy have always been an important appendage of the habitations. This simple, economical and commodious arrangement (for nothing in the second and third stories prevents the small r room F from becoming an anteroom opening into the two large rooms D and E) accorded well with the procedures and materials of construction of Burgundy, which furnishes excellent hard stone, suitable to place those thin stair enclosures projecting on the ends of the steps of the first revolution.

Further, on examiniing the habitations of this epoch which still exist in one province, if one finds that certain general arrangements of plans were adopted by all at the same moment, as according with the needs, yet one finds in the details and in the mode of piercing the windows, an extreme diversity. Because during that fine phase of the middle ages, the feeling of individuality was not extinguished; everyone thought rather of satisfying his tastes or his personal needs, r rather than to imitate his neighbor, and to model himself on a uniform type. No municipality would have cared then to impose on all owners in the same street a uniform height of bands and a uniform style of architecture, and in that century, which men point out to us as a time of oppression, the idea would never have occurred to any authority whatever to mould t the habitations of a thousand citizens on the same type. Each one then had too much consciousness of his own individuality, and his personal responsibility, to suppose that men could be penned like animals in a zoological garden in similar barracks to please the eyes of idle loiterers. One will note in the e elevation in Fig. 13 the arrangement of the stone gutters inclined toward the two end gargoyles supported on projecting corbels. That is an arrangement still common in Burgundy and in upper Champagne. Besides, where long and resistant stones are lacking, these gutters are simply hollowed in a beam or in a plank covered with lead. From the middle of the 13 th c century indeed in Burgundy and Champagne, men avoided allowing water from the roofs to fall before the facades, but led it by gutters to projecting gargoyles placed vertically above piers of the party wall.

We saw at Vitteaux fifteen years since several charming houses of the 13 th and 14 th centuries, nearly all demolished

or changed today. One of them, dating from the second half of the 13 th century, presented in plan the following arrangement (14) of the ground story.

At A beneath the enclosure of the stairs, as in the preceding example, is the entrance door. The door to the cellar opens on the street at B. Having passed th entrance door, one passes into the little vestibule C; from thence directly into the kitchen D and to the left into the hall. The same arrangement is repeated in the second story and gives two chambers; then in the third beneath the roof is a great room divided in two in the depth of the building. The elevation (15) shows at A the entrance door, and at B is that of the cellar. The enclosure of the stairs is no longer supported on the euds of t the steps, but on a well jointed rampant platband. At the top the enclosure of the stairs passes from the cylindrical to t the hexagonal form, so as to facilitate the covering by wooden tiles. An internal court, or rather a planted garden behind the house, gives air aud light to the kitchen and the rear pa part of the hall. The building next the garden is enclosed by half timber work (see plan). Profiting by the projection given by the corbelled stairs, and by a corbel vertically over the pier of the left party wall, the architect has placed a projecting unequal truss to shelter the entire facade (see elevation). Water runniug in the partly wall gutter is thrown to the left on the street by a wooden gargoyle, and to the right into the court by a wooden duct emptying into a small stone reservoir placed in the corner of the kitchen. In the ground and second stories are fireplaces arranged in the party wall, and chimneys with caps are visible in the elevation. Thus on an area of about 1076 sq. ft., and of which 160.8 sq. ft. were reserved for the construction, the Burgundian architect of the little city of Vitteaux found means to erect a h house capable of lodging properly a family in sanitary rooms, well lighted and sufficiently spacious, evidently for a very moderate sum; for one notes that the front and party walls al alone are of masonry; the floors rest on these two party walls and on the middle half timber partition. A structure of this kind of the style adopted would cost in the province, 1 including the cellar, $4.65 per sq. ft. the house would then come to the amount of $2,450. Now we can see the structures

daily erected in the little cities of the departments; on an area of such little extent they cost more, are less sanitary and convenient, but also they are remarkably ugly, although they endeavor to resemble the great house of a citizen of t the nearest great city. Not entirely the richness of ornamentation pleases in these civil structures, since they are generally without sculpture until the 15 th century; nor is it t that common symmetry so much prized by modern city officials. What pleases and charms in those modest buildings is the imprint of the needs and habits of the family sheltered by them; the sincerity of the procedures of construction, the unexpected, the skill and mind, let us say, with which the artist has known how to profit by all the conditions of the given programme. Assuming that our modern cities were buried under ashes like Pompeii, it would be very difficult for archaeologists, that discover them two thousand years hence, to obtain an idea of the tastes, manners and habits of the generation that erected them; but if one enters today a tolerably preserved house of the middle ages, everything in those habitations recalls to us the mode of life of their occupants. There one feels a people with its own character, distinct tastes, its traditions and tendencies.

Further, the mansion of the lord and even the house of the citizen, that has become an important personage in the city, are distinguished from the dwelling of the citizen, merchant or manufacturer in a striking manner. If the citizen places his facade on the street and tends to live on the street, on the contrary the noble erects his mansion behind and between a court and garden; on the public street he places an enclosing wall or offices. Just as the house of the simple citizen resembles a lantern, so much that of the lord or of a man become a great personage is closed to the eyes of the passer. We have seen somewhere that the marquise of Rambouillet was the first in Paris to have the idea of building for herself a mansion between a court and garden, that is one of those errors like so many others insistently propagated to make it believed, that the 17 th century did everything, and that before that epoch was nothing but darkness and barbarism. First Tallemant des Reaux, who alone among contemporaries of the m marquise speaks of the care, that she took in the construction

of her mansion, says not a word of this, and had he said it, the mansions existing much before that epoch would have given him the most complete contradiction. Indaad the mansions of S. Pol, Tournelles, Bourbon, Tremoille, Sens, Guise, op Cluny at Paris, were and still are between a court and garden. It would then be easy in a city to recognize the habitations of important personages from those of citizens. But the houses of the citizens themselves had a particular stamp because of the condition or position of those inhabiting them. The houses of a manufacturing and commercial city like Beauvais, Amiens or Rheims or Troyes, do not resemble those of a city inhabited by landed proprietors living on their incomes, on commerce in grain, wines or other products. If the house of a citizen of Rheims or Troyes is open in the ground story or elevated on a portico, for example, to allow the merchants to discuss their affairs, that of Provins or of Laon, for example, is carefully walled on the street to the height of the second story. Fig. 16 reproduces the facade of one of those houses of Provins, looking on Rue de Paris, and dating from the second half of the 13 th century.

Here the inhabitant shuts himself up; the outside has nothing to do with what passes inside. The hall is in the second story as well as the chambers. The ground story is reserved for the offices, provisions and kitchen. The stories are high between floors' one feels that in these habitations life is simple and broad. Further, one will observe with what care the c construction is executed, how the openings of the windows are well relieved by those stone discharging arches; how that facade is composed of so few elements, yet it takes a monumental character. To know how to put art into a rubble wall pierced by openings aud without any decoration, without costly procedures in construction, limiting it to that strictly necessary, is in that the mark of a very advanced social condition, from the point of view of art, and can we say as much of our city? We are not ignorant that for a great number of persons today, art is only an expansion of luxury, a superfluity, and that in the matter of architecture the facade not faced by columns or pilasters, by mouldings collected nearly everywhere according to the fashion, is not at all a work of art. The middle ages letf few books or discourses on art, but whoever was an

artist knew how to put art on the richest facade and on the w wall of the humble dwelling of the citizen of a little city; he knew how to love and respect that art in its modest expressions as in its splendid conceptions. An age that no longer believes itself able to manifest its taste for art except by accumulating ornaments, or by spending enormous sums, but which in works of every day forgets its elementary principles, passes from one type to another, no longer possesses originality, and that century tends to the debile of the arts. When an epoch has descended to this inferior level in the history of the arts, the execution is gradually impoverished; no longer employed except for privileged works, it retires from the extremities to concentrate its last efforts on some points; barbarism daily gains more area.

Men still build palaces and monuments where every richness is piled without order or reason; but the habitations, the d edifices of the small city, are no more than coarse works, r ridiculous and uniformly vulgar, whose defects in construction promptly do them justice. It is the only remaining consolation in the midst of those wretched things, to minds sufficiently occupied with art matters, to believe that posterity will yet judge somewhat of civilizations by their monuments. When art is no longer a matter of luxury, the day of its proscription is near. In the middle ages the vital power of art is manifested everywhere; its expression is a need for all, great and small. The old houses that still covered our old French cities a few years since, and that new needs cause to disappear rapidly, were the living proof of this. We do not claim, at the cost of the public health with the development of the prosperity of the middle classes, that there must be preserved even the rotten hovels; but we should love to find again today in our private structures those instincts of a people loving the arts and knowing how to propagate everywhere their true expressions. But no, this old and rich Gaulish blood, that after l long compression could circulate freely in the 13 th century, carry life into the provinces, cover the soil with edifices of every nature, original, logical, frank and without alloy, the true enclosures of the nation full of brilliant qualities; this limpid and pure blood has coagulated anew under a second foreign invasion. It has been necessary again to become Romans,

and yet under what Romans! Symmetry must refplace logio, and pallid imitation of a dead art is substituted for the native originality of our oountry. False doctrine persistently taught has taken root in every mind, and infatuation for a showy art that none understands or explains, because it cannot be explained before minds naturally clear and logical, has replaced that innate taste for that true art formed for us, and in the midst of which we feel ourselves at home.

The house of the middle ages in France is the habitation of a man born on the soil. The house of our time is the common d dwelling, uniformly comfortable; as the life of the merchant, his customs and needs, resembles the life, customs and needs of the soldier; as if the lodging suited for a notary would be adapted to a woman of fashion. That uniformity is inconvenient for us on the whole, and is such that the man devoted to a career todan is compelled to have a house built for himself, if he desires not to daily have to struggle with the w weariness and the difficulties caused by the ordinary lodging. Everyone is ill at ease in the box that he has rented, but p passers see only facades nearly identical, and which would have already caused us to die of melancholy, if in our country we could fall under the power of that malady! [1]

Note 1.p.246. It is necessary to be truthful; excess in France soon leads to reaction, and everything leads one to believe that the orgies of symmetry to which men have been left since the beginning of the (19 th) century, and particularly for some years, will lead to a universal revolt against this barbarous fashion of understanding the art of architecture.

But (and that is a motive to not despair of the future) it is no in our time that men have attempted first to mould, let us say, the inhabitants of a city into regular divisions, aligned and identical. The lords of the middle ages did not understand much better than our modern municipal officials questions of art, but which has not prevented the nation from possessing its art. Notably the English do not seem at that time to have fathomed French genius; and in their condition of foreigners, we cannot wish them to have done so:- "In the second half of the 13 th century, a time of peace and prosperity," says M. Felix de Verneilh, [2] " a little corner of one of our provinces was rapidly covered by those new cities called

"bastides" (walled towns) in the language of the South. Let us see by what circumstances Alphonse de Poitiers, brother of S. Louis, had become by his marriage with the heiress of the counts of Toulouse the nominal lord of a part of Guienne." As such and although that sovereignty was frequently reduced to a title, he claimed to ensure his direct authority by causing the building of a capital, Villefranche de Rouergue. "In Agenois he founded Villeneuve d'Agen and several less important market towns. In Perigord, where he had some possessions, he also founded bastides." Those cities or bastides were built on lands granted freely, according to the recommendation o of the engineers, and enjoyed extensive franchises. This was one means of attracting to a direct dependence on the sovereign entire peoples; the means succeeded in spite of the protests of the feudal lords and the excommunications of the bishops. "On his part," continues M. de Verneilh, "Edward I, first as duke and soon as king, greatly multiplied foundations of that kind; and this is one of the best titles of that great prince to the grateful memory of the old duchy of Guienne. Among others, Libourne owes to him its existence (1286)." Beaumont was thus built for the account of the king of England in 1272; Marshal Jean de la Lande commenced on his own domain the bastide of La Linde. The city of Montpazier was built about 1284. Now that plan of Montpazier drawn in 1284 has not since been changed. Like all plans of cities of that epoch, traced in Guienne and Perigord, the city of Montpazier is not only aligned with perfect regularity, (Art. Alignement, Fig. 1), but also all houses are of equal dimensions and are arranged in the same manner. A block of houses of the city of Montpazier (17) shows with what cellular uniformity those habitations a are built. Certainly the regularity observed in modern cities, like Napoleon-Vendee and certain cities of Algeria, is only disorder in comparison with that absolute symmetry. It must be admitted (which would then be true), that all men settling in those privileged walled towns, a sort of refuges offered by a sovereign, were all on a basis of equality; whatever they were, it is certain that they submitted to these conditions of alignement, of facades anf areas imposed, since those cities were built at one spurt, and attained a degree of very high relative prosperity shortly after their construction.

Note 2.p.248. See Annales archaeologiques. Vol. VI. p.71. Few archaeologists have made in our time studies so complete and rich, as M. Felix de Verneilh has done in what concerns the cities of the middle ages in particular.

Thus one recognizes that these ideas, which we believef belonged to our own epoch, of workmen's cities, of centres of population established with an appearance of absolute equality, are not new, and that the middle ages attained therein a practical point, from which we are still very distant. But however modest are those habitations, they are at least in relation to the needs and habits of the epoch. They all consist of a ground story, a second and sometimes a third story; their facades vary in appearance, because the tastes and fortune of each one; further they are well built and solid. The square of the city alone, at one side of which is the city hall, is surrounded by very wide porticos, low and ending at the stairs affording entrance to that square; for the engineers that traced the plans of those walled towns carefully refrained f from having the streets pierce the middles of the sides of t that square, which would have conformed to academic rules, b but not at all to those of reason. A square is generally in a city an area more or less large where men gather; if two streets cut the middle at right angles, it is clear that passers inconvenience muc those remaining there. To establish circulation along the sides of a square and leave the middle without circulation has always been the purpose of the founders of the cities of the middle ages. Cut-off angles arranged at the square returns of the corner houses permit wagons to enter the square easily on market days. We present (18) the plan of one quarter of the town of Montpazier,[1] and (19) the perspective view of one entrance to that place taken from the point A of the plan. One sees in that Fig. how the angles of the houses are supported by corbelling above the wide cut-off angles, that afford entrance diagonally to the square.

Note 1.p.248. At Montpazier the properties have all their side walls. This arrangement is even retained around the square, where there exists a portico; this is an exception to t the rule.

The houses of those walled towns of the end of the 13 th c century are built of stone, brick or rubble; wooden construction

is excluded from the facades. Further, wooden houses are very rare in the southern provinces, while from the end of the 13 th century we see that they gradually become more common in the northern provinces. At first it is only the upper stories that are built of half timber work, then soon the ground story alone remains in stone; then finally during the 15 th and the beginning of the 16 th centuries, entire facades are not only erected in half timber construction, but frequently they are even entirely of wood like large furniture, without any visible trace of masonry. Besides the taste that the peoples of the north have always retained for wooden structures, besides the enfluence exerted on those peoples by the traditions brought by southern invasions, the vicinity of great forests, wooden construction presented advantages, that must lead all inhabitants of the populous cities of the French provinces, properly so called, to employ this method.

As we have stated, in those great cities of the north, such as Paris, Rouen, Beauvais, Amiens, Troyes, caen, etc., the s square was rare. These cities were surrounded by walls and c could not extend as in our days; then men sought to gain in height the area lacking in plan, and they infringed as much as possible on the space of the public street by means of corbelled stories; now wooden construction lent itself alone to these arrangements imposed by necessity. Men then thought of sheltering the surfaces of facades by the projection of the roofs, whether the eave or gable wall was built on the street. The streets gradually became narrower as the cities became richer and more populous without baing able to move o out their walls, and the windows were enlarged to admit the most light possible. But on that subject, we must place an o observation here. In our time, and not without reason, men a aim to light abundantly the interiors of rooms of a habitation; it was not so during the middle ages. The earliest Romanesque houses are pierced by windows relatively narrow and allow little light to pass, the inhabitants seeking obscurity in interiors with as much care as men seek light; there were still traces of an antique tradition. In the 13 th century, houses began to have wides windows; one sees at least a hall well lighted. This taste extends as an active life, industry and commerce assume more importance among the urban population.

All conditions had need of the light of day to devote themselves to their occupations. The house was no longer the closed refuge of the family, it was also the workshop; thus in the industrial cities the houses were widely opened on the street from the end of the 13 th century.

In spite of the opening of the facades of tha epoch, one scarcely conceives today, how in those narrow streets bordered by houses with overhanging stories, certain industries could be exercised; that is explained only when one has seen, f for example, the silk workers of Lyons work on the most delicate fabrics in rooms in which one would scarcely believe that he could read. Sight accustoms itself to obscurity, and the excessive natural or artificial light, that we introduce everywhere today, is not an absolute requirement for laboring on works of great delicacy. However that may be, from those workshops of the middle ages, that seem so dark to us today, came works of woldsmiths, embroideries and fabrics, when with all the light that we have, we attain their delicacy with difficulty. These are only questions of habit, and of what a workman is accustomed to from infancy, to work under a doubtful l light, it does not follow that this workman i unskilful. So that when our fathers saw the Cid of Corneille played by the light of candles, it is unnecessary to conclude that they appreciated less vividly the masterpiece of the tragic poet. On Onee for all, let us leave there those reproaches made to the architects of the houses of the middle ages for having made dark and uninhabitable hovels; gloomy and uninhabitable for us maybe, but the citizens of that time found them commodious and sufficiently lighted. That was independent of the question of art; the greater or lesses architectural quality of the facade of the house does not depend on the greater or lesser width of the street on which it stands. We have the proof of this every day.

Here (20) is one of those houses built of masonry and of w wood, that we drew at Chateaudun in 1841. The ground and second stories are built of stone, the party walls of rubble; the re rear wall on the court is also of stone. In the ground story (see plan A) opens on the street a vast storehouse with a central post and wall pier B. A main girder rests on a corbel of the pier of the middle of the facade, on the central post and

on the head of this wall pier; it receives the floor beams. A partially open screw stairs ascends to the second and third stories. From the corridor C one passes into the court D and into the rear hall E. On the second story the arrangement is similar, except that the girder passes through the front wall and receives the tiebeams of the carpentry. To obtain the most possible light from the street, the constructor has turned two discharging arches in the thickness of the front wall, and beneath these arches he has set actual very open stone sashes. The story of the roof is divided into two rooms in depth of the building. One notes that a carpentry truss projects on t the front wall so as to properly shelter it. That truss rests on the ends of plates held by ties and on the end of the axial girder also held by ties. The beams of the floors are set at the levels G and H. The construction of this house belongs to the beginning of the 14 th century. But in this example the roof story is not set on corbelling.

Fig. 21 gives the plan and elevation of a house of Laval a of a little later epoch, but in which the wood construction assumes more importance and is lorbelled from the ground story. This house, whose facade rises on a street having a strong inclination, is divided for two families. The slope of the street has permitted the constructor to give a lower entrance f for the occupant at the left, the beams of the floors being at B and C; the occupant on the right has only a high ground story and a second story, the beams of the floor being at the level C′. As indicated by the plan P, each occupant has his stairs ascendiug from the shop to the second story. A half t timber partition placed on the axis of the facade separates the two habitations from the top to bottom. The half timber f front of the second story projects beyond the plane of the n half timber front of the ground story, and rests on these beams corbelled out (Art. Pan de Bois). This half timber work of the second story is sheltered by the head truss of the roof s set on the ends of the plates S. The front corner posts are there only to maintain the half timber frace next the street, for behind these corner posts rise the party walls of rubble supporting fireplaces. Here the masonry of the facade stops at the height of the ground story of the left habitation, and lower for the right one. The half timber frame, as on the pre-

preceding example, is let into masonry between the posts, discharged and staggered.

These two examples already show with what freedom the architects of houses employed these simple and sensible methods that they had to follow; profiting by the arrangement of the localities, the slopes, the quality of the materials, satisfying the given programmes without adhering to conventional forms, but still observing scrupulously the principles of solid and durable construction. It was indeed necessary for those principles to be good, that habitations erected by the aid of such simple and inexpensive means could endure for five centuries.

At the time when half timber corbelled frames seem to prevail for urban habitations, this mode is not subject to the s same system of construction in all provinces composing the F France of today. Wise and choice in the provinces north of t the Loire, toward those of the Centre and East it retains a primitive appearance. For example, in Bresse the wooden houses of the 14 th and 15 th centuries possess half timber frames in which the system of horizontal timbers, still used in Switzerland today, is apparent and combined with the system of f framed carpentry. This system of horizontally piling beams, besides belonging to certain peoples, whose ethnic character is recognizable, is also caused by the abundance of resinous trees, straight like the fir of the Vosges, Jura and Alps. If it be indeed difficult to pile horizontally oak trunks, that require length and troublesome squaring, on the contrary nothing is easier than to place on each other trunks of fir, naturally straight and easily squared. In the provinces of the East and even in those of the Centre, forests being abundant and numerous in the middle ages; notably on the upper Loire, the Loire and Ardeche, part of ancient Lyonnais, the mountains now arid, four centuries ago were covered by secular forests protected by feudal laws. Thus it is not rare to find still o in those provinces old wooden houses, evidences of the abundance of that material. In the little city of Annonay exists, or still existed some years since (for those old habitations disappear like leaves in autumn), a small number of houses of the 14 th and 15 th centuries almost entirely built of wood, whose construction merits being studied, and that have escaped the fires of the 16 th century. We give (22) one of these,

which we classify among the houses of the 14 th century.

On a ground story built of great blocks of stone is placed a deep series of fir timbers, the third row forming a floor and projecting in fronh so as to carry as corbels the half timber frame of the second story, composed in front of three superposed sills and jointed, on which stand the verticals. Two corner posts receive the ends of those sills. At the sides i ordinary half timber work filled wit rubble and mortar, forming party walls. On this first half timber frame a second corbelled floor receives a third story of like framework, surmounted by a roof projecting much on the street, whose construction is sufficiently explained by our Fig. The projection of the roof from the face of the wall of the ground story is about 11.5 ft.; thus the facade is perfectly sheltered from rain and snow; these habitations were then appropriate for t the climate of that province, hot in summer and very rough in winter. It is easy to recognize that this sort of wooden houses do not at all resemble those erected north of the Loire. There are different traditions and different needs. The citizen of the cities of Lyonnais required less light and more efficient shelter. For example, at Annonnay it was desired n not only to protect the facades from the snow squalls, but al also the steep streets, so as to facilitate the circulation of the inhabitants in winter. Because in the middle ages, whatever may be said by the detractors from that epoch, the citizen did not shut himself up in that brutal egoism so general today; in building his house, he also regarded himself as a citizen and built for himself and his city. In our time the street regulations are established to protect common interests. Then the regulation of the streets were certainly less complete and less foreseeing, but each citizen thought a little more of the general interest and desired to ensure the we wellbeing of all. Now that combination of general and particular interests adhered to by all the inhabitants of the same city is more intelligent, than could be the most complete and best executed regulations. From the point of view of art, the result is quite interesting otherwise. It is in that like private compared with public charity. If the latter be regular and perhaps more efficient, the former is more delicate and intelligent. But we do not have to occupy ourselves with that

sad side of our modern civilization, which seems ts require continual praise to avoid injurious comparisons. Let us return to our domestic architecture.

The construction of houses of horizontal timbers is better characterized if we approach the Alps. At Nantua are still s seen some houses of nearly the same epoch as that of Annonay given above, bu whose construction more nearly approaches t that of the Swiss habitations called chalets. One finds very old traditions in these houses (23). The manner in which the half timber framing of the second story is placed on the masonry, the double plates under the roof, belong entirely to the primitive structures of certain peoples, that only employed the method of carpentry by horizontal timbers, while the form of the front truss forming a shelter of certain parts of the half timber work approaches the framed carpentry so common in the north of France. It is necessary to hasten to make a complete and critical study of those old remains of habitations on Gaulish soil,for that study can powerfully aid in classifying the races distributed over the territory. Religious edifices and castles are erected under influences frequently foreign to the soil, where we find ourselves today, while the houses retained till very late the primitive traditions of the indigenous peoples. For example, in England one cannot mistake that all wooden structures of the 14 th and 15 th centuries, still numerous, have a great analogy to the art of naval c carpentry. The connections of timbers, their relative strength, the frequent use of curves, recall constantly the combinations of the carpentry of vessels; while at the same epoch in the north of France we see employed a method of carpentry, only composed of vertical timbers with cross-pieces, relieved by some X-braces; in the East a very old method, and which more or less seems to belong to this nucleus of the people, t that occupied the entire area between the upper Loire, Saone, the Alps and the Jura; in the West anf South, a very restricted system of carpentrw, that only consists of floors and roofs, allowing the mason to erect the front, side and division walls.

Note 1.p.257. The construction of the cholets is most interesting to study, and it is one of those most nearly approaching in Europe the wooden structures of the primitive ages.

We are very far from believing that the houses of certain

provinces in the middle ages differed little from those erected by their peoples before the Roman domination; the Romans exerted an influence on the mode of construction of houses only in certain provinces, in Provence, and a small part of Lyonnais, Languedoc, Saintonge, Angoumois, Perigord and a part of Burgundy. Besides that everywhere traditions dating back to high antiquity were preserved, and about the 14 th century, except in Provence and Languedoc, occurred a reaction definitely antiroman, from the point of view of the construction of habitations. It would appear that at that epoch the old Ga Gaulish nation returned in building its houses to an art, whose principles had remained in a latent state. Secular feudalism, far from restricting that movement, on the contrary seems to have aided it, certainly not because ofa particular t taste for a form of art, but because of its secret hate of m monastic institutions, that as we have said above, had retained Gallo-Roman traditions quite purely. The middle ages consists of very different and of frequently opposed elements; it is difficult without entering on long explanations to render ay account of the effects, singular in appearance, that were produced suddenly within peoples continually at work. In the habitation of the citizen and of the man of the country, as much as in the political history, one finds traces of the national movement, that commenced during the reign of S. Louis, and that continued with marvellous activity during the 14 th and 15 th centuries, through that time of invasions, wars and miseries of all sorts. It seems that then the inhabitants of the cities, that possessed the practice of the arts, sought in all constructions to depart from the traditions preserved by the monasteries; they returned to wooden construction, and devoted themselves to bold combinations, that carpentry allows; they opened more and more the facades of their houses, so as to compose the stories of open fronts, that seemed to make t the life of the citizens in common. It necessarily produced from this intimate vicinity a more complete fellowship between the citizens; without being obliged to descend into the p public street, they could hear each other and plan together. In certain streets of the 14 th century, the occupants of the houses formed a cabal by opening their windows. This political need of agreement made necessary ay the state of the struggle

of the citizen class against clerical and secular authority, explains those arrangements of houses, that seem so odd to us today, whose houses with very open facades form impenetrable streets, and which nearly touch at the ridges, leaving at their bases a passage very easily intercepted. The great question for the citn then was concentration, the union of means and the complete understanding at a given moment; then forced to group the houses as much as possible, and to place their inhabitants in direct communication. Facades of carpentry lent themselves much better than those of masonry to those concentrated arrangements and to that system of open fronts; further, they occupied less of that so precious land. These is then no reason to be surprised, if among the urban peoples that had acquired at the 13 th century privileges and a certain independence, who had become industrious and rich, that construction in wood had been almost exclusively adopted. In the cities of the South, in which the traditions of the Roman municipility were never entirely lost, and which had not been forced to react violently against the feudal power, particularly against the clerical feudal power, that had become heavier for the cities than the lay authority, domestic architecture retained the masonry construction, the arrangement of relatively wider streets, and did not adopt those entirely open facades, that so to speak, placed all the inhabitants of the city in contact with each other.

We have just stated that the clerical feudal power then weighed more heavily on the cities of the North than any other. One recalls how the bishops about the end of the 12 th century were preoccupied with the exaggerated importance assumed by the monastic establishments, which had absorbed for their benefit a grea part of the diocesan authority on the one hand, and beiug desirous of encroaching on the lay feudal power on the other hand, had an understanding with most of the great cities situated North of the Loire,[1] to erect cathedrals that should become the monument of the city, in which the inhabitants could assemble at their pleasure, discuss public affairs and have their lawsuits judged:[2] how the bishops thus hoped to destroy the colossal power assigned to the abbeys, and lessen that of the lay lords; how that attempt was at first seconded with extreme ardor by the cities, but partly failed as a res-

result of the protest of four barons delegated in 1246 to the king Louis IX, and by the establishment of the royal bailiffs; yet how the citizens formed a more intimate alliance with royalty, that they felt thenceforth the protecting power, abruptly ceased to assist the construction of those immense basilic-asl,to struggle against the feudal power of the bishop and c chapters, until then the most extended in the city. That struggle was often sustained by the lay lords and tolerated by t the royal authority, when if found therein a means of extend-its own authority, had as a result the maintenance in the midst of the people of those cities an incessant fermentation, a and of giving them an idea of its strength, if it remained w united. Hence those habitations so intimately connected and so near, all constructed on nearly the same programme followed until the end of the 15 th century.

Note 1.p.260. Noyon, Senlis, Paris, Bourges, Chartres, Rouen, Sens, Arras, Amiens, Cambrai, Rheims, Laon, Soissons, Beauvais, Auxerre, etc.

Note 2.p.260. Because of this reasoning, "that the Church by virtue of a power that God had given to it, must take cognizance of all that sinned, so as to know whether it should remit or retain, bind or loose." This was certainly an encroachment on the judicial power of lay feudalism in general.

It is always necessary for us to enter into the customs of the middle ages when we desire to find the reason for its architecture. The Romans spent a great part of their time in t the public monuments, the basilicas, under the porticos, in the baths and the edifices intended for sports, theatres, circuses, amphitheatres, etc. Although in our days the great cities contain many public monuments, still when one looks at the plan of ancient Rome, on which the monuments occupy such a g great comparative area, one asks where such a numerous population lodged; the Romans scarcely lived at home except to eat and sleep (we do not speak of those possessing immense palaces, whose areas occupied a considerable space). On the contrary in the middle ages, in cities of the north of France, each fa family lived in its house; the citizens had no occasion to assemble, and had the cities been sufficiently rich to erect n numerous public edifices, the principle of feudal government would have been opposed to this. The church was the sole mon-

monument of the city in which the assemblage of citizens was permitted; thus is explained the enthusiasm with which populous cities came to the aod of the bishops, when they projected the construction of great cathedrals. But when that outburst was suddenly stopped, the citizens found in the royal authority serious guarantees, they began to erect habitations with entirely new ardor, and wood lent itself marvellously to the quick satisfaction of those needs; econocy, and still more important, the small area occupied by the solids. Everywhere also till the end of the 16 th century, architecture followed its regular course, improving the houses, making them lighter and more commodious, but continued to employ Romanesque methods. The form alone vas modified. One sees in Burgundy, Lyonnais, Limousin, Perigord, Auvergne and Languedoc, houses of the 14 th and 15 th centuries, which differ from those of the 12 th and 13 th centuries only by the style of their architecture.[1] Neither the construction nor the arrangement of those habitations is modified in a sensible manner. In the most southern provinces also, that which in the 14 th century was not French, were seen at that epoch habitations, whose style absolutely retained the Romanesque character. For example, such are some houses of the city of Perpignan; one of those houses, since devoted to the service of the palace of justice, presents a facade in a taste nearly antique, in spite of the details borrowed from the Arragonese style of that epoch.(24).[2] At the eastern side the traditions of Romanesque construction continue till very late in the habitations, i.e., till the 15 th century. Certain houses of Treves, Cologne and Mentz, that were erected at the beginning of the 13 th century, could pass for Romanesque houses in Ile-de-France and Champagne. One even yet finds in some of those habitations particular arrangements, which belonged in France only in the 12 th or beginning of the 13 th centuries; for example,such are fireplaces with flues corbelled out beneath the front walls above the second story (Art. Cheminee). We give (25) the facade of one of those old houses of the city of Treves, that dates from the beginning of the 14 th century, and that shows its chimney in the middle of the gable wall on the street.

Note 1.p.281. Arch. civ.et dom. of MM.Verdier et Cattois.

Note 2.p.281. The little columns of the second story of th-

this house are of marble; the rest of the facade is built of stone and small rubble. One will note the exaggerated jointing of the voussoirs of the central doorway, the platbands of the lateral openings of the ground story. These are the remains of traditions very far removed from those of the provinces of the north.

The hearth is placed as indicated by the fragment A of the plan, and the flue is terminated by the cap B that rests on t three corbels in the form of capitals and on two little arches between the windows of the second story. It must be quite pleasant while warming to enjoy the view outside. Windows so pierced permit working near the fireplace, and to warm one's self without being inconvenienced by the reverberation of the flame. The persons in that time thus had their comfort, and from what we know of accommodating ourselves today, it does not follow that ours may be wore wisely understood. However primitive t that comfort, at least the architecture was entirely subject to it, while today our architecture (at least what it is desired to persuade us is ours) is in a perputual discord with our habits in interiors.

Let us return to the houses of French cities of the 14 th and 15 th centuries. Wood decidedly dominates in their construction at that epoch, and generally gable walls present themselves on the street, the lots suitable for building having greater depth than breadth, by the reason dominating all cities, that the front of the site is most prized. Yet if the s site be a border, which sometimes occurred, the gable walls were placed on the party walls, and the front half timber wall on the street was the eave wall. Here (26) is a house of Beauvais [1] presenting that arrangement. On the ground story was a portico with shop behind it, as one still sees at Rheims.[2] t The second story on the street consists of two rooms, to which one ascends by the screw stairs placed at the end of the passage A. Beneath the roof was a great room lighted by two dormers, one on the street and the other on a little court. That house dated from the beginning of the 15 th century. There yet exist some houses of this kind at Orleans, excepting the portoco.

Note 1.p.285. This house existed on the square of Beauvais in 1834, at the eastern side.

Note 2.p.263. Of a later epoch.

After the war of independence in the 15 th century, when the English were compelled to abandon the North and West of France, there was under Louis XI a pronounced movement of prosperity in the urban peoples. Private structures arose in great number at Paris, Rheims, Orleans, Beauvais, Rouen, in all cities of Normandy, Picardy and Ile-de-France. Because of this need of building, land acquired a considerable value, and while l leaving free circulation at the ground story by suppressing even the porticos, whose piers or posts were an obstruction, the facades were corbelled into the street from the level of the floor of the second story. These facades thus became actual galleries, wide and giving the stories up to 6.6 ft. projection beyond the front of the substructure. The fronts of t the shops were therefore perfectly sheltered. This system of construction was particularly adapted at the ends of the streets on market squares, nearly always surrounded by posts.

One still sees at Rheims [3] a house with facade of half timber work, perfectly preserved from top to bottom, projecting 5.4 ft. into the public street (26 bis), corbelled out on 5 strong braces. At one side a party wall A of stone supports the fireplaces, and its supporting pier receives two braces. At the other the party wally is only a simple half timber framework. The wooden statues attached to the corner post near the stone pier no longer exist; but the two lower end braces are sculptured in half relief, at one side being Samson slaying the lion, at the other S. Michel beating the demon. This front framing forming a projecting gallery, since it receives side light, is constructed with great perfection; indeed its connections must be perfectly arranged, since the carpentry has suffered no deformation, although in its entire height are no X-braces. The spaces between the posts are filled by masonry and plaster.

Note 3.p.265. Place des Marches.

Likewise here (27) is a house of Rouen in half timber work in 4 stories, a little earlier than the preceding, i.e., belonging to the first half of the 15 th century, and that forms the angle of two stories.[1] The half timber frame of each story is corbelled out from the others (see section A), so that the third story has an area sensibly larger than that occupied by

the ground story. The cornice at the base of the gable represents a series of machicolations.

Note 1.p.266. Rue de la Tulle. The drawing of this house w was furnished by M. Devret, architect, who at the Salon of 1 1881 exhibited several old houses of Rouen and of Orleans drawn with extreme care. The ministry of State, at the request of the committee of historical monuments, also caused a certain number of those houses of Orleans to be drawn by M. Vaudoyer.

In the 15 th century the windows of wooden houses ar multiplied and small; that was a necessity of construction, therefore when the half timber frame attained a great height. Indeed this sort of structure, by even the nature of the material employed, is subject to bending. Great sashes of windows would frequently have been deformed, compressed or bent by the movement of the wooden timbers. It would have been constantly necessary to remove and refit them, while small sashes were less affected by changes in temperature, or more readily followed the movements of the carpentry. Besides, one notes that the sills of these windows being carefully fitted wit X-braces prevented the movement of the door posts, and that the weight of the half timber frame is transferred to the corner posts by being relieved at each story. But the inhabitants of those cities of the North sought more and more to open these wooden facades. At the end of the 15 th century frequently they made actual lanterns, as prowed by the example opposite (28), also taken from a house at Rouen.[1] Only the sills with their X-braces prevent the swaying of the wooden frame, also made with the precision of a work of joinery. Thus also at that so epoch the wooden house loses the character of a carpentry construction to take that of furniture, of an immense chest.

Note 1.p.268. Rue Malpalu. We also borrow this drawing from the work of M. Devret.

In Fig. 28 the masonry panels below the sills are still visible; soon these disappear behind panels of joinery, and the entire front of the house only presents an assemblage of woodwork. On this basis were built many houses at the end of the 15 th century and the beginning od the 16 th.

Fig. 29 reproduces the part of the habitation of the abbey of S. Amand at Rouen, and shows above a ground story of masonry two stories entirely of wood, ornamented externally by car-

carved panels of joinery. When a little later with the Renaissance men returned to stone structures, that habit was so strongly retained, that there were built a great number of wooden houses, but on which were found however the forms of pilasters and bands, that did not belong to the system of construction in carpentry. There still exists in Rue de la Grosse-Horloge at Rouen two houses of this kind, that are covered by precious details. We give (30) a part of one of them. [1]

Note 1.p.210. These houses also form a part of the work of M. Devret, but will soon disappear by reason of cutting a new street. It is to be desired that these precious facades should be deposited under shelter in some public monument of the city of Rouen.

The 16 th century saw erected also such stylish houses, the last reflection of the art of the middle ages. After the disasters of the end of that century, the houses returned to the simpler style, but the plans were modified very little, and many houses of the time of Henry IV and of Louis XIII reproduce exactly the plans of the earlier habitations. It was only under the reign of Louis XIV, that the houses (we are not speaking of the mansions) lose all external character. Then nearly all walls are plain or are timber frames with panels filled with roughcast, pierced by rectangular windows, without anything to occupy the eyes; but the interiors are also profoundly modified.

The hall, that we also find in the habitations until about the beginning of the 17 th century, gives place to the chambers. The areas are divided; each man wishes to be by himself, and the customs of life in common disappear. One understands how a family became attached to its house, when the common hall, that even served for the chamber of the masters, had seen the birth and death of several generations, had witnessed festivals in its interior, had long been trodden by the feet of friends; one comphenends then how each citizen held to having his house pleasant and decorated; but one does not understand the luxury spread over the facades of ordinary houses, in which the occupants left but a fleeting memorw. Naturally the appearance of those houses must be as common as t their use. From the point of view of art, is that an advance?

From the examples of urban habitations that we have presented

in this Article result a series of interesting observations. The individual character of these houses is striking; now we range ourselves with the opinions of those, who claim that t the moral condition and its vitality are by reason of more or less responsibility left to each one. The true civilization, that civilization distinct from a policed state, fertile and active, is that in the midst of which the citizen retains the fullness of his individuality. The theocratic or despotic civilizations of the East are destined to cast a brilliant gleam at a given moment, then to gradually become extinct, to never rise again. There indeed the citizen does not exist; there is the sovereign, the theocracy or the aristocracy, then a multitude of men whose passage is only marked by those prodigious monuments, like those of Egypt, India or of Asia Minor. In s such a state the house does not exist; between the palace and the mud hovel is no intermediary, and again all the mud huts resemble each other in form and dimensions. To the northern races that emigrated to the West, taking wit them those great wagons containing their families, actual rolling houses, that were fixed on the ground on the day that the tribe conquered a place, to those races alone, the Greeks of antiquity at their head, it was given to build houses, i.e., habitations indicating the habits and tastes of each one, modifying them in accordance with the changes operating in those habits and tastes. The feudal system was indeed imposed on France by conquest, although repugnant to the Gallo-Roman peoples, was not made to destroy individualism, personal responsibility; on t the contrary, it developed with energy this sentiment natural to the western peoples, it established the struggle for a permanent state, it allowed a last recourse against oppression by the employment of the feudal mechanism itself; for every individual oppressed by a lord could always resort to the sovereign, and every municipality could, sometimes joining the party of the bishop, sometimes that of the lay baron, make a final appeal against tyranny. That certainly was not a regulated and policed state, as we understand it; but neither was it a state contrary to the intellectual development of the i individual. Thus the individual was something in the cities of the middle ages, and consequently his habitation retains a d definite and recognizable character.

The absolute goveenment of Louis XIV almost entirely stifled that sentiment so active until the end of the 16 th century, and the house of the French citizen lost all individual character in the 17 th century. The city habitation became a family storehouse. Uniformly built, opened or arranged, those dw dwellings absorbed the citizens, who lost on entering all individual appearance and no longer recognized themselves, so to speak, except by the names of streets and numbers. So we see that in England, where the feeling of personal responsibility, of the distinction of the individual was much better preserved than among us, the inhabitants of the great cities, if they possessed houses nearly similar in appearance,at least possed them by families, and only with difficulty lent themselves to that assemblage of numerous renters in the same habitation. This fact seems to us to have a moral significance of high importance, and it is not without lively satisfaction, that we see in our days this feeling of the distinction of the family, of individualism, take possession anew of men, and react against the enervating system introduced into France under the government of Louis XIV.

Everyone desires to have his house; now if the vast majority of the inhabitants of our great cities cannot yet satisfy that taste in the city, at least let one seek to free himself from the bad conditions of the common dwellings by erecting those myriads of little suburban houses, that occupy our suburbs, and in which even families with small fortunes can pass a good portion of the year. It will be one of the glories of the existing government of France, to have known now to take the most radical measures to arouse this healthy tendency of minds; for in our opinion the State cannot call itself morally civilized until the day, when each citizen will possess his proper residence, in which he can raise his family, where he will leave the memories of the good that he has been able to do, or the services that he has rendered to his neighbors. T The walls speak, and a man that would do a shameful act in t the rented lodging, that he will leave in six months, will h hesitate between the walls belonging to him, and where his children will grow up, to leave himself to his evil tendencies.

It is now necessary for us to speak of mansions, i.e., of city houses belonging to lords or to wealthy private men, and

that occupy quite extended areas, which enclose courts and ga evensometimes gardens, but which do not affect the defensive arrangements of the feudal castle, and that are not equipped with towers and crenelated walls. As we stated in commencing this Article, the mansion does not habitually have its living apartments on the public street, but rather the common rooms and dependances, and sometimes a simple wall with the porter's lodge. As the citizens and the merchants adhere to participating in the daily life of the street (further it is for most of them a necessity), so the noble and the wealthy capitalist at the head of many attendants adhere to shutting themselves within their houses, to live a feudal life in the city, isolated, having no habitual communication with the exterior. The character of the mansion, or if one prefers, that of the house of a noble, then differs entirely from the house of the c citizen. This kind of habitation has been compelled to suffer even more changes than the houses of the citizens. Occupying larger areas, having successively belonged to wealthy persons, they have been modified according to the taste of the day; we no longer find in France mansions preceding the 15 th century, or at least the remains left to us have but a mediocre value.

One of the oldest of those mansions is still seen at Provins; it belonged to some rich canon of S. Quiriace. It consists (31)"of two distinct buildings, separated by a vaulted passage. At the left is found the great reception hall placed in the second story; this is reached from the court by an external stairs of wood. Three double windows opened in the facade opposite the church and light this room; it was warmed by a great fireplace of stone, and covered by visible carpentry wi with a trussed ceiling. At the right of the passage is found the kitchen and two rooms placed between the court and garden, and that served for the habitation."[1]

Note 1.p.275. Arch. civ. et dom. by Verdier & Cattois. Vol. II. p. 205.

In some of the flourishing cities of the South, scarcely k known today, there exist habitations of the 13 th and 14 th centuries, that partake of both the mansion and the house. T The rich capitalist of those municipalities on the banks of the Garonne, Aveyron, Tarn and Lot, withing which Gallo-Roman traditions were very well preserved, when he built his mansion,

desired to nave storerooms on the street, either for use in his own business to to let. Those mixed structures were freq-uent at Toulouse, Alby, S. Antonin, Cordes, Gaillac and Vill-eneuve d'Agen.

We give (32) the plan of one of tnose mansions situated in tne main street of the city of Cordes opposite the promenade of Bride.

On the right and left of the entrance A are the storerooms or shops opening on the street. At B is the principal court and at C is a little service court reached by a passage D. Th The open rcom E probably served as a stable. F is a cellar. A wide winding stairway G gives admission to the great hall H in the ground story, raised seven steps above the ground of tne court. A passage I communicates with a garden K, situa-ted outside the old rampart against which is built the mansi-on. Buildings of a late epoch have been partly erected on the garden from a to b. The shops L L had access into the court and probably those occupying them lodged elsewhere, unless these storerooms were for the use of the owner of the mansion. The great stairway G ascends to the second story in a hall situated over H, and communicates by a wooden passage M with the front building with area only divided by partitions. A third story also rose above this front building, and was ser-ved by the grand stairway and a second passage. The stable and tne cellar only had a ground story. A little terrace N with flight of steps opens on the court opposite the hall H.[2] This habitation dates from the first years of tne 14 th cent-ury, and has all tne characteristics of the mansion of the middle ages, although the shops open on the street, and the front building serves for lodgings in the second and third stories.

Note 2.p.275. These plans were drawn by M. Thomas, ex-arch-itect of Tarn. M. Thomas has made a very interesting work on the houses of Cordes, deposited in the archives of the monum-ents historiques.

The data that one can collect on the mansions of the 13 tn and 14 th centuries in the cities of the North are not suffi-ciently complete to allow us to give plans of those habitati-ons. We shall only state that they contained courts with por-ticos on one or two sides, and a building retired anf looking

on the court and on a garden, with the offices placed in the vicinity of the street. The oldest edifice of this kind still entire is the mansion of Jacques Coeur at Bourges. It is on a fief established on the walls that enclosed the city, that Jacques Coeur erected this splendid residence.

Note 1.p.276. By a charter of 1224, Louis VIII permitted the inhabitants of Bourges to build on the ramparts. Several towers and curtains thus became private property. In 1443 Jacques Coeur purchased from Jacques Belin for 1200 crowns the fief c comprising two towers of the ramparts of Bourges on which he built his mansion. (See Antiq. et les Mons. du Berry, by Hoze. 1834.

We give (33) the plan of the ground story.

The towers S, R and Q formed a portion of the ramparts of the city and were utilized. S was crowned by a rich crenelated pavilion, and the stairs to it was thus attached to the tower Q. The arrangement of the rampart formed a very obtuse angle on which the face of the wall was built, obliging the architect to give to his buildings the skew arrangement, that we s see reproduced in the construction. But then little attention was paid to symmetrical combinations, and men profited by the site as much as possible. The entrance to the mansion is at A on the street, and consists of a gateway with a postern B at the side; the stairs F ascends to the chapel located over the entrance. Thus from the exterior it was easy to reach that c chapel without entering the interior of the residence. From the entrance A for carriages or riders, and from the postern B, one entered the great court C under an enclosed portico D and beneath that at E. The last portico opened on a court G, having a party well G'. At H is the principal stairway, giving entrance in the ground story to a great dining hall I and a service passage J, communicating with the kitchens placed in K and K'. The kitchen K' had a hearth with fireplace and a stove for soup. From the street one could directly reach t the kitchens by the corridor L and the little service court L', connected with the great court by the passage L". The great dining hall was heated by an immense fireplace c, and was accompanied by the little gallery I' intended for musicians. Th That gallery was reached by the stairs f without passing through the hall. On the floor of the hall I a trapdoor i gave a

access to tae cellars. That trapdoor was reserved for the use of the butler, who could thus bring the fresh wine directly into the hall at the time of the repast, or indeed as some claim, it permitted him to cast the silver ware into the cellar in case of fire; this we cannot decide. The great fireplace had an opening of 19.7 ft. and was richly ornamented; its mantle represented a fortified city, and at the two sides two nude statues of Adam and Eve were separated by the tree of k knowledge. M was the pantry from which by a wheel m the dressed dishes were passed into the hall. The little straight stairs noted in that pantry descended into the lower story of the tower S, which thus served as an annex to the pantry. Opening into the little kitchen K is below the oven and a vaulted lavatory, paved and with a gargoyle ending in a cesspool. Privies for the servants were placed beside that lavatory under the solid stairway. A stairs n connected that kitchen with a mezzanine of the tower S, and a second story by means of the screw stairs t. The little court L′ has a fine well with spout, permitting the filling of tanks arranged in the great kitchen K. From the kitchens the meats were brought into the pantry by the passage J, that ended under the grand stairway H. Passing beneath the stairs O one found a corridor directly connecting the great court with the place of Berry P. At T T′ are two great rooms, whose purpose is unknown, but which by their position appear to have served as chambers with wardrobe placed in the square tower R. That entire angle, including the tower Q, formed a complete and independent apartment, since one could descend from the great chamber T′ into the little court by a stairs g, or ascend to the upper stories. The porter's lodge was at V. As for the gallery D, it served as a place for the assemblage of the poor, to whom were distributed the remains from the table of Jacques Coeur. The poor thus had no access into the mansion, and could await under shelter, u until from the kitchen was brought what was reserved for them. The stairs X, H, O and g ascend from the ground to serve the upper stories.

If this plan be irregular, one should recognize that its a arrangement is well understood. Each service is in its place, the communications between them are easy and yet are independent. On the right of the entrance is the kitchen service with

its court, its special exit and its great portico for the distribution of alms. Opposite is the principal stairway for the upper apartments and the dining hall of the ground story. On the left is a complete and independent apartment with its court and its portico permitting private entrance or exit. Many mansions of the 17 th century are far from presenting arrangements as convenient and well studied.

Fig. 34 traces the plan of the second story of the mansion of Jacques Coeur. The principal stairway A gives entrance to the great hall B, which has a platform like the great halls of castles. The living apartments were at C; they were placed in communication with the great hall B and with the gallery D by service passages and direct exits. From the gallery D one passed to the chapel E, to which one also ascended directly from the lower vestibule by the stairs F. Another gallery G likewise connected the chapel with the hall I and the separate apartment K, which had a private stairs L. The service of the principal apartment C was by the stairs M or by the stairs X. The salon I found an exit by the stairs N, the great hall B itself, besides the grand stairway, was served by the second stairs O. In the second story as in the ground story, the different services of that mansion were made independent, and t the rooms intended for receptions could not interfere with t the private arrangements of the inhabitants. As in the castles, one sees that the programme compelled the architect to find combinations of very complicated plans to satisfy the tastes or particular needs of the owner. It is certain that the numerous lobbies were disguised and appeared indispensable, and that all idea of symmetry was sacrificed to the requirements of the habitation as then understood. One will note that the apartments intended for habitation, besides the great rooms, consisted of numerous lodgings, cabinets and wardrobes, that could not fail to be very convenient; that all these rooms, great and small, are lighted.

By utilizing the Gallo-Roman towers and ramparts, Jacques Coeur was perhaps not sorry to give his mansion the appearance of a feudal domain, and in great part the retaining of those towers required the irregularities of this plan. Besides, the architecture adopted lends itself to those defects of symmetry, and nothing is more picturesque or more brilliant,

than the interior of that court with its stair towers, its se separate roofs surmounted by chamney caps, finials, dormers, and lead crestings, formerly painted and gilded.

We present (35) a cavalier view of that mansion taken from the point P′,(see plan of ground story). The construction is everywhere treated with extreme care and the sculpture is in a charming style, appropriate to each service, mingled with emblems, devices, hearts, plumes and shells. Thus over the three openings of the chapel stairs, in the tympanums, the sculptor has placed a priest clothed in the alb and blessing the water; behind him a young cleric rings for the mass; then comes the beggar leaning on a crutch, as if to indicate that the holy place is accessible to all. The second relief represents the clerics preparing the altar. The third a woman arriving for the office, preceded by a child, that opens the door. At the top of the stairway is a fourth relief representing the Eternal Father with two angels in adoration. Above the doorway of the stairs is sculptured a wide fireplace before which hangs a kettle, a child turns the spit, a woman washes the dishes, and the cook pounds spices an a mortar.

Among the devices on several tympanums, or painted on the glass is read the following:- "To brave hearts nothing is impossible." Then these enigmatic words:- "God to do to be silent for my joy." Or indeed this proverb:- "Into the closed mouth enter no flies." Jacques Coeur had adopted as arms:- azure with band or charged with three shells sable, accompanied by three hearts gules placed 2 in chief and 1 in point.

The vaults of the chapel are entirely painted; in each triangle of that vault is an angel clothed in white holding a scroll, and detached from a blue ground with gold stars. One knows how the illustrious parvenu capitalist of the 15 th century paid dearly for this magnificence. The man is one of the most remarkable individuals of our country. This habitation is then an edifice interesting from all points of view, among those that we possess in France.[1]

Note 1.p.281. This charming edifice was converted into a palace of justice, and has suffered numerous mutilations. Now placed in the hands of one of our most distinguished colleagues, M. Bailly, we are assured that it will be restored with the care and respect, that it merits.

We have now come to the end of the 15 th century, and to d describe one of the most charming mansions of that time, so rich in structures of this kind.

There still existed in 1840, Rue des Bourdonnais, a mansion called de la Tremoille; it was a regular fief created at Paris under Charles V and held directly from the king, later from the bishop. It was rebuilt about 1490 just as we have seen it, by Louis de la Tremoille, born in 1460. This Louis de la Tremoille captured the duke of Orleans at the battle of S. Aubin-du-Cormier in 1488; which did not prevent the Valois after b becoming king of France from conferring upon him the command of the army of the Milanese in 1500. He was killed at the battle of Pavia. Here (36) is the plan of the ground story of t that mansion.

The entrance gate A was accompanied by its postern a, and opened on Rue de Bourdonnais; it gave entrance into a quite spacious court, having near the entrance a portico with a return at the right side. At the back rose the principal b building. Beneath a small tower supported by two columns at the left at B, was a passage connecting the court with a g garden that extended to Rue Tirechappe, and which at that side had a carriage gate with buildings at right and left f for carriages and horses. A great flight of steps C gave entrance into the great hall D, the principal stairs E, the hall F by the door G, and the little vaulted room H, by descending some steps. Continuing to descend, one reached the cellars, well ventilated and spacious. Another door I with flight of steps allowed one to penetrate directly from the court into the two rooms M and L. A second service stairs N ascended to the upper stories and even served the roofs. At O was a little court with well. The kitmhens and thei dependances were found in P; they were in great part destroyed and included in an adjoining property. A portico R joined to that of the entrance from Rue Tirechappe allowed one to pass under cover from that kitchen and offices into the principal building by crossing the lower landing of the service stairs, thus arriving in the dining hall m. The porte 's lodge was arranged at V at the side next Rue Tirechappe. At Y was discovered a well built s sewer, that formerly conducted the rain and waste water under that street. In the second storw the arrangement of the main

building was the same as that of the ground story; the division wall b was omitted, the two rooms L and M profiting by t the width of the passage B, and the latter gave admission to the oratory or cabinet placed in the angle tower. The portico Q formed in the second story only a single bent gallery from the point S to the point T. That gallery was abundantly lighted from the court, but on the street was only pierced by three small windows. The great building alone between the court and garden had a second story, served by the two stairs E and N. The building of the kitchens, offices and portico R had only a ground story. At X we give a block plan of the mansion de la Tremoille with the entire garden and buildings of the offices.

The architecture of that mansion was one of the most graceful creations of the end of the 15 th century. The left tower, the grand stairway, the porticos with their second story, had suffered but little mutilation. As for the facade of the building on the court, it had been much injured, but all the elements of its ornamentation remained in parts beneath the modern stucco. Next the garden the facade was very simple. What one cannot admire too much in this charming architecture was the delicate taste displayed by the architect. The assemblage of the plain and the decorated parts was most happy. All that was torn down in 1840. Together with the commission of historic monuments, we then made the most urgent endeavors to preserve this masterpiece. Yet we could not obtain more than the transfer of some fragments to the Ecole des Beaux Arts, where they can still be seen built into the left wall on entering.

We give (37) the facade of the main building comprised between the tower and the stairway.[1]

Note 1.p.284. For the details of this tower and stairway, see Arch. civ. et dom. of MM. Verdier & Cattois. Vol.II,p.

Everyone knows the mansion of Cluny, that now contains a m museum of objects from the middle ages, and which is built on the baths of Julian; that edifice is is of the same time as t the mansion de la Teemoille and presents an analagous arraggement. On Rue des Mathurins rises a crenelated enclosing wall, the building being situated between a court and garden. We borrow from Baron de Guilhermy this summary of the history of that mansion.[2]

Note 2.p.284. See Itiner. archaeol. de Paris. Paris 1855.

"In the first half of the 14 th century about 1340, Pierre de Chasles, abbot of Cluny, purchased the site of the palace of the baths with the intention of erecting there a lodging near the college, that his abbey possessed opposite the Sorbonne. This project does not seem to have been followed by execution; for it was only at the end of the 1: th century that Jean de Bourbon, one of the successors of Pierre de Chasles, undertook the construction of the edifice, which still r remains. When that prelate died in 1345, the foundations scarcely rose above the ground. Jacques d'Amboise, who united the titles of bishop of Clermont, abbot of Cluny, abbot of Jumieges and abbot of S. Alyre, resumed in 1490 the work of his predecessor, and carried it out to entire perfection."

More fortunate than the mansion de la Tremoille, the mansion of Cluny was preserved, due to the collection that Du Sommerard knew how to gather there, and to the European reputation soon acquired by that museum of objects of the middle ages. In 1342 the State purchased that museum and the collection t that it contained, caused to be ceded by the city of Paris the remains of the baths of Julian, and today that entirety has become the meeting place of all that take some interest in m matters of the past.[1]

Note 1.p.286. M. Du Sommerard, son of the founder of the c collection, since 1843 has been conservator of this museum, w which by his intelligent direction, increases daily and is o one of the richest in Europe.

We give (38) the plan of the ground story of this mansion. The building for habitation is larger than that of the mansion de la Tremoille, but the garden was less extensive. At A is the principal gateon Rue des Mathurins-S.-Jacques with its postern A'. The porter's lodge is at B; then rises a portico C, that gives entrance to the rooms H of the ground story, rooms also entered from the grand stairway F by a little door f. The kitchen is at D with its flight of steps and its private stairs P, having also an exit outside on the floor of the kitchen and in the room H'. A door g affords a direct entrance from the court into that kitchen. At I is a room behind on the garden with aigle stairs R, having a door into the garden, o one to that room I and to the corridor L. At K is an open hall, a sort of covered yard under the chapel in the second story.

F is a court with entrance O in one of the antique halls of the baths. M is also an antique hall in which were probably placed the stables. The corridor L formerly communicated with the privies. The wall on the street is crenelated and was furnished with a wodden defensive gallery borne on corbels now destroyed, and replaced by wrought iron angles. A little stairs S permits one to descend from the room I into the covered yard K and to ascend directly to the chapel. The garden G is 55.8 ft. wide by about 115.0 ft. long, and was bordered by private properties. The principal stairway F is terminated by a platform reached by a little screw stairs starting from the attic story. The mansion of Cluny, like that of de la Tremoille, p possesses cellars, ground storw and second story, and an attic mansard story. The structures are very well preserved. The old floors, composed of girders receiving the beams, are still vi visible, and several fireplaces date from the primitive construction. Although the architecture of the main building has not the elegant delicacy of the mansion de la Tremoille, yet it lacks neither grace nor style. The wendows are happily placed, the stairs are very skilfully arranged and the chapel is a little masterpiece. It has a little apse borne by corbelling on the external pier of the covered yard. Like that yard it is vaulted, and its four cross vaults rest on a central column.[1] Fig. 39 gives a cavalier view of that mansion, taken from the entrance side.

Note 1.p.287. For the details of this mansion, see Statistique monumentale de Paris, published by M. A. Lenoir, under the direction of the ministry of public instruction.

There still exists at Paris a mansion of the end of the 15 th century; this is the mansion of Sens, which served as a r residence of the archbishops of Sens, when they sojourned at Paris.[2] This mansion is situated at the crossing formed by t the meeting of Rues de l'hotel de ville, du Figuer, de l'Etoile, des Barres and du Fauconnier. It was erected by archbishop Tristan de Salazar from 1475 to 1519. The numerous mutilations suffered by it have taken away its character almost entirely.

Note 2.p.287. The bishopric of Paris until in the 17 th century was suffragan of the archbishopric of Sens.

One still sees pretty mansions of the Renaissance and of the

beginning of the 17 th century in some provincial cities. Mansion de Prince at Angers is a charming edifice of the 16 th century; that of Vauxluisant at Troyes, which dates from the first years of the 17 th century, is remarkable for its plan and the happy outlines of its buildings. At Toulouse remain still a great number of mansions of the 16 th century. The w work of Du Gerceau (Les maisons des villes) presents numerous examples of good plans and of buildings in excellent taste.

If the houses during the 17 th century were scarcely more t than vulgar lodgings, in which it is difficult to find a trace of art, it was not the same for mansions. Under the reigns of Henry IV, Louis XIII, Louis XIV and Louis XV, Paris, Lyons, Toulouse, Bordeaux, Caen, Nantes, saw arise a number of beautiful mansions, that still retain the arrangement of the habitations of the nobles and of the rich citizens of the middle ages and the Renaissance. Mansions Lambert, Carnavalet, Mazarin (Imperial Library), Pimodan, Soubise (Archives of the Empire), are still models of grandeur and of good taste, that depreciates all that has been done in that kind in our days. Because it is easier to acquire wealth than the feeling of grandeur of taste.

MAISONS DES CHAMPS. Country Residences.

As we stated in commencing this Article, the country house should not be confused with the manor house. The manor house is the habitation of a gentlemen, a chevalier, who does not possess the feudal rights of high and low justice, but who is a landed proprietor, and who has no other service to pay the sovereign than personal military service. (Art. Manoir). The country house is the habitation of the farmer, colonist, renter, tenant and the peasant. The country inhabitants renew their dwellings less frequently than those of the cities, first because they are poorer, then because their needs vary little. A citizen in our days has retained none of the habits of his ancestors, while a peasant in the middle of the 19 th century lives nearly as one of the 14 th. Thus the more one descends the scale, the less differences are found between the country dwellings of the middle ages and those of our times. In passing over the country in our French provinces, which have been especially removed from contact with the inhabitants of the great cities, like certain parts of Languedoc, Correze, Auver-

Auvergne, Berry, Saintonge, Brittany, Upper Marne, Morvan, J Jura and Vosges, one yet discovers secular habitations, that have been but slightly modified, and that furnish us very p probably by transmission examples of the dwellings of Gallo-Roman country inhabitants.

Indeed in these habitations one recognizes the use of certain procedures in construction, that retain all the characters of a naive art, and if the material be crude and the workmanship be coarse, the application of the principle is correct and sometimes impressed with that charm attached to the primitive arts, for whoever knows how to see it. There still exist in the middle of the forest of Morvan certain peasants' houses in which a countryman of the Edui would find no change, if he returned after 18 centuries; and we have even seen on the banks of the Loire and Seine and in the Vosges, peasants' living in caves excavated by human hands, which are preserved just as the Roman armies could have seen them. The variety of these country dwellings on the soil of France is one of the proofs of preservation of ancient traditions; for if all our city h houses resemble each other today, it is not less so in the country, and the thatched cottage in Picardy does not at all resemble that in Brittany' the latter essentially differs from the cabin in Morvan, that recalls in nothing that of Franche-Comte, Auvergne or of lower Languedoc.

We happened to stop in certain villages in France where each house was built for a single owner, and retained a character of primitive roughness, very far removed from our modern civilization, where all tends to lose its special appearance. We think that we shall be expected to give here the houses of t the peasants classed by certain epochs, as we have been able to do for minor habitations. The transmission of some types accepted for centuries also forbeds that classification. Since we have brought ourselves to believe, that certain provinces have not ceased to erect the same rural dwellings since the epoch of the invasion of the barbarians, it is evident t that we could with difficulty distinguish a house of the 10 t th from another of the 14 th centuries. We shall then content ourselves with furnishing some of those well characterized ty types, without assigning them any precise epoch and the less, because these structures were generally built with the aid of

very small resources, and have not been able to resist the e effect of time, have retained ttha primitive character only by the repetaition of the same procedures, the use of the same materials and conformity to the same habits. However the oldest rural houses, or at least those that appear to have suffered the least alteration, belong to the provinces of the Centre and the East. In Morvan, the lod peasant's house only presents externallw a mass of piled stones. Walls built of great blocks of granite and pierced by little openings, a very low ground story serving as cellar, storeroom, poultry or swine house. Door raised 3.3 ts 6.6 ft. from the ground with a flight of steps and a landing engaged in the wall; ceiling formed of great beams with joists. Garret above protected by heavy carpentry covered by stone plates called "laves" in the country (40). Each house contains only one room with its fireplaee; if one wants two rooms, there are two houses joined at t the gables. No decoration in that house, nothing to present a taste for even the rudest art. The timbers are scarcely squared, the floor is covered by tamped earth covered by a layer composed of granitic sand and clay.[1] If one approaches Nivernais and upper Burgundy, on the contrary one frequently finds in the houses of peasants traces of art; the lintels of the doors are cut with care, the jambs are well dressed, the interiors are plastered and are sometimes wainscoted to the height of the window sill. The timbers are squared and even chamfered; tiles from ancient times replace the heavy stone r roofing. Sometimes the external stairs are tastefully arranged, the landing having fine stone railings; the joists of the ceilings project on the exterior, forming a cornice and join the rafters (41).[1] These country habitations in Burgundy are often faced with care and assume certain architectural forms.

Note 1.p.290. In these houses of such a poor appearance, it is not rare to find peasant families comparatively rich and possessing very considerable property. Among these peoples, nothing is sacrificed for comfort. Their only preoccupation is to possess land and to amass crowns to increase their little domains.

Note 1.p.291. Between Dijon and S. Seine.

The houses of peasants still well preserved in the village of Rougemont between Montbar and Aisy furnish the proof. These

houses mostly date from the beginning of the 13 th century, and present their gables to the street, are built with remarkable care (42), and nearly all possess a story over the ground story; but it must be stated, that this village depended on a rich abbey. Indeed in the vicinity of the religious establishments the houses of the country men were best built until the 14 th century, and those houses are habitually constructed of masonry. Suenon [2] says that the land destined for the habitations of the peasants around the agricultsral establishments of the religious was divided in equal parts. "We believe," says M. L. Delisle, [3] "that this rule was frequently followed in our province (Normandy), where for a long time the word "boels" has had the sense of court or hut. To the colonists were then assigned the lots, usually longer than wide, from which was the common name of 'long boels'. At one end of the lot each one built his hut. All the doors opened at the same side on the road, that became the street of the village." That arrangement is observed at Rougemont and in many other farming centres belonging to the abbeys during the 12 th and 13 th centuries.

Note 2.p.291. Leges Scaniae. Book IV. Cited by Ducange under Boel.

Note 3.p.291. Etudes sur la condition de la classe agric. en Normandie au moyen age. p.386. Evreux. 1851.

In the North, in Normandy and Picardy, the country habitations, the lot was an enclosure with a house generally built of wood. On the banks of the lower Seine, Orne, Dives, on the shore of the Channel from Eu to Cherbourg, the Normans left still visible traces of their special genius. The houses of the peasants are half timber frames filled with earth mixed with straw, covered by thatch or wooden tiles. If after some years the old habitations of those provinces tended to disappear to be replaced by small houses of brick covered by slates, a great number were still to be seen in 1830, that recalled by their construction the carpentry of Norway, Denmark, a and those indicated in the tapestry of Bayeux. The Normans, like all peoples of Scandinavia, built only in wood, and were good carpenters from the epoch when they came to establish t themselves on the coasts of France. Navigators, their habitations retained something of naval construction. The manuscripts

regarded as Saxon in England, and preserved in very great number in the British Museum, present in their vignettes specimen habitations, that also recall naval structures.

In Norway and Iceland still exist some of those carpentry structures of a quite recent epoch (16 th century), but which reproduce accurately the form and procedures of a much older art. In those habitations, as on the embroideries of the tapestry of Bayeux, for example, one notes the kingposts richly ornamented, tha terminate the two ends of the ridge, and that are connected above the roof by a timber cut out like a c cresting. One still saw in the country of the Eure not long since slight remains of that tradition clearly expressed in our Fig. 43. Those Norman houses of the 11 th and 12 th centuries contained only a rather high hall lighted on all sides, covered by carpentry rudely ceiled. The hearth was placed near the middle of the room, and the smoke escaped through a w wooden duct passing through the roofing of thick wooden tiles.

In the provinces of the Centre, like Auvergne, Velay and t the southern part of ancient Aquitaine, it seems that Celtic traditions were retained very far into the middle ages. The houses of the inhabitants of the country were in part excavated in the ground and covered by a sort of pile composed of earth and piled stones on timbers placed radially around a principal beam. An opening made at one side of this pile served as door and window, and the smoke of the hearth escaped by an opening at the middle of the pile. We have seen in the mountains of Cantal habitations of this sort, that appeared ancient, and that were a tradition from a very ancient epoch. It is unnecessary to state that art nowise entered into this sort of habitations. Certain huts in Bocage and in Brittany indeed have some relations with these, in that the internal ground is lower than the external soil, and that the roofs covered by thatch descend nearly to the ground. But these habitations do not assume the conical form externally, they are covered by gable roofs with two gable walls of dry stones or of half timber frames filled with mud.

Approaching the banks of the Rhine, in the provinces of the East, in the mountains of the Vosges, near the little lakes of Guardmer and Retournemer, one sees still the habitations of peasants, that present all the characters of wooden log

construction. Low and wide, well built to resist hurricanes and to support snow, they have a strange appearance. Those h houses are nearly always composed of three rooms in the ground story and four rooms in the attic (43 bis). The plan A of one of those houses is taken at the level of the ground story, and presents at B the entrance hall, from which one passes e either into the great hall C or into the rear room D, which has the only stairs ascending to the second story under the roof. In the hall C, lighted at the two ends, assembles the entire household for meals and in the evening. Also in that room is prepared the food. A great chimney with jambs, back, mantle and flue of masonry passes through the roof. That is the only part of the building together with the base, that is not of wood. The covering is made of tiles, schist or thin slabs of sandstone; it is further loaded by stones. The houses stand on a substructure about 3.3 ft. high made of great blocks of sandstone. A partition composed of trunks of trees rudely squared divides the house at the middle lengthwise and supports the upper ends of the rafters. This and the two side walls join the two gable walls, are corbelled out and thus f form the great projections of the roof. A floor of joists rests on these three parallel wooden walls. Those buildings receive light only through the wooden gable walls. It is difficult to not see in these houses a very ancient tradition, that approaches the wooden structures of old Switzerland, so interesting to study.

On the banks of the Garonne, in Languedoc and Provence are found the most graceful rural habitations, those best recalling the country houses of antique paintings. Roman tradition has remained purer in those provinces than elsewhere in France. Those peasants' houses are large and spacious, low, always orientated in the most favorable manner, possess porticos or rather open sheds, low so as to shelter the inhabitants in t that mild climate, who devote themselves to their labors outside the house.

In the plains of Toulouse, in Ariege and Aude, the coast of Limoux, in the midst of groups of century trees are seen houses built in this way, and that are relatively early, i.e., da date from the 15 th century. Besides, those still erected today of unburn bricks and pebbles follow exactly the same programme.

In fact those peoples have always been agricultural and attached to the soil, and have but slightly modified their habits since the 14 th century. Here (44) is one of those rural habitations.

The system of tenure at half rental of fief farms was customary in the provinces of Languedoo as it is today. The peasants holding those farms as renters ran less risk than those who leased for a term, or who obtained a concession of lands for a fixed rental; they lived in a more complete state of s security. This explains the character and comfort observed in the rural habitations of that country, and also their uniformity for several centuries past.

In the North and especially in Normandy, the system of rental for half, or of a perpetual concession for a fixed rent, was generally replaced after the 13 th century by the lease for a term. The lord retained the property in his lands, and he ceded the use of it to a farmer for a limited time and on fixed conditions. "Several causes," says M. Delisle, "favored the development of that tenure, and they preferred it to a perpetual concession. In the first centuries of feudalism were scarcely known the latter; but men finally perceived that the rent fixed by a lease in time lost the greater part of its va value. This consequence was inevitable, not only from the change in value of money, but also from the change operating in the relation of money to articles purchased. On the other hand, the weakening of the feudal system tended to deprive the lords of the principal means previously employed for utilizing their domains not granted. Thus one conceives how they were brought to treat with the farmers. They relieved themselves of the co cost of cultivation, and were no longer exposed to see their fortunes reduced to rents, whose nominal value was unchanged, but whose real value became more and more insignificant." Even sometimes the lord needed ready money, and received from t the farmer in passing the lease the total amount of the rental for several years. It is evident that these actual loans were made on hard conditions for the owner and tended to enrich t the farmer. Thus in Normandy rural habitations are seen to t take a considerable relative importance and to be modified more rapidly than in any other province.

Note 1.p.297. Etudes sur la condition de la classe agricole en Normandie au moyen age. p.51. Evreux. 1851.

On the shores of the Mediterranean one sometimes finds country habitations, that assmue the form of a tower or little k keep, and that belong to a quite remote epoch; but these dwellings were occupied by pirates rather than farmers. There exist several of those between Toulon and Cannes.

Here (45) is one of them still entire, built at the entrance of the village of Cannet near Cannes, half way up the hill a and about 2.5 miles from the sea. It consists of a square tower having two stories above the ground story with no communication wit the exterior. The doorway is elevated 9.8 ft. above the external soil and was accessible only by means of a ladder, that could be drawn up easily to avoid troublesome p persons. The second or rather the third story (for the only communication with the ground story was by a trapdoor placed in the floor of the second) is pierced by six machicolations in the form of hoods and has no windows. The second has no ot other opening than the door. From that story one ascended to that with the machicolations by a miller's ladder.[1] The rope ornament that decorates the lintel of the door indicates a v very early epoch. At Cannet this tower is known by the name of the house of the brigand. The last story is vaulted in rubble under the roof. Also in Corsica are seen a certain number of habitations of this kind.

Note 1.p.298. We owe these drawings to the courtesy of M. Merimee.

These country habitations, arranged in a manner to serve as a refuge for some men living isolated and probably evilly with their neighbors, are also found on the western coasts. One of those best preserved and most important exists near Bordeaux (46); it was formerly surrounded by a ditch filled with water. A flight of 12 steps engaged in the wall led from the level of the water to the raised doorway. Perhaps a plank was thrown across the ditch when one desired to enter. That door gave admission to a single room of the second story, furnished with a fireplace and pierced by a small window and six slots.

This communicated with the cellar by a trap opened at the centre of the room. By taking the screw stairs was reached t the third story with a fireplace like the second; slots and a bay were placed over the entrance doorway.[1]

Note 1.p.300. These drawings were furnished by M. Durand, architect at Bordeaux.

There have been mentioned to us several of these habitations on the coast between Bordeaux and Bayonne and even beyond, to S. Jean de Luz. We incline to believe that those houses date from the epoch of the English domination in Guienne. Indeed, one sees in the county of Suffolk in England a small house (Wenham Hall) built in the same manner, and which dates from the end of the 13 th century, That structure is a parallelogram with screw stairs in a little angle tower. The entrance being elevated, it is reached by steps engaged in the wall.

There should not be omitted here the houses built in cemeteries, the houses of the cross, that were free of outside secular jurisdiction, and served as asylums for pilgrims and the sick, and which were placed under the supervision of the religious. These houses were recognized by a wooden cross fastened on the roof.

MANOIR. Manor House. Manor. [2]

Note 2.p.300. (Latin note).

The manor house, although this name sometimes designates a castle, is the habitation of the owner of a fief, noble or n not, but not possessing feudal rights allowing him to erect a castle with towers and keep. But the manor house is closed and it can be enclosed by walls and surrounded by ditches, but not defended by towers, high crenelated curtains and a formidable fort. The manor is a coun ry house, from the architectural point of view, placed between the feudal castle and the house of a vassal, a class superior to that attached to the feudal lands, a free man. "These sub-vassals," says M. Delisle [3] with regard to the position of this class in Normandy, "essentially differed from the nobles, who only held their fiefs by good faith, homage and military service." But in certain lordships, they owed military service, mounted, armed with lances, shields and swords. The dwellings of the sub-vassals, and even of the eldest, i.e., of those holding from the lord lands more or less extensive, who united several sub-vassals in their hands, and who remained responsible for the service and rentals of the sub-vassals of the group, could not be regarded as manor houses, because they were not enclosed.

Note 3.p.300. Etudes sur la condition de la classe agric.

The manor house is sometimes only a house of small extent,

surrounded by walls and with a garden; more frequently it is a collection of buildings devoted to agriculture, enclosed by ditches and wit a principal building for the habitation of the proprietor. The villas of the kings of the first race of the kings were rather manor houses than castles, and until the 16 th century the great sovereign lords in France, besides t their castles, that were veritable strong places, were pleased to erect pleasure houses to give themselves to the pleasures of the chase, or to retire for a certain time; those houses may be regarded as manor houses. Many royal abbeys possessed within their enclosures manor houses, to which princes ca came to rest from affairs. (Art. Architecture Monastique). T The pleasure house of Bicetre near Paris, or rather of Winchester,[1], which was burned by the people in 1411, was a great ma manor house rather than a castle, although it had one tower.[2] Under the kings of the third race Fontainebleau and Blois were likewise great pleasure houses, that had the character of the manor house.

Note 1.p.301. Because in 1204 it had belonged to John, bishop of Winchester. (Sauval, Antiq. de la ville de Paris. II,72.

Note 2.p.301. The ruins of the manor house of Bicetre are seen in an engraving representing the ballet given by the count of Soissons at the Louvre in 1632. Count Horace de Vielcastel has furnished us with precious data on this subject.

England has preserved a very considerable number of these c country houses of the 13 th, 14 th and 15 th centuries; but in France we know none, that are entire and date beyond the 1 15 th century. The manor house, properly so-called, always c contains a hall like a castle, and in England the name of manor house has been retained. In fact in these residences the hall is the important part of the programme until the 15 th century.

In the 12 th century king Richard of England had at Southampton a manor house, that served as a gathering point at the t time of embarcation. That building consists of a hall, a chapel and a cellar.[3] A private chamber was often placed beside the hall.

Note 3.p.301. Dom. arch. of the 12 th century, by Hudson T Turner, Parker. Oxford. 1851.

The name of manor house is sometimes applied to the house

of a guest, or a colonist, when that house is surrounded by an enclosure. (Old French poem).[4]

Note 4.p.301. Roman du Renart. Verse 8893.

The arrangement of the manor houses at the end of the 12 th century and during a part of the 13 th, was the same in France and in England. The abbey of S. Maur possessed at Piple near Bossy-s-Leger a manor house on which depended 33 acres of vineyard wit two presses and 10.5 acres of forest. Abbot Pierre I about the middle of the 13 th centurw caused the manor house to be rebuilt in part; there by his order was built the chapel, a hall with cellar beneath, and a lodging surrounded by walls and wide ditches.[1] Yet from the 13 th century the distinction between the castle and the manor house was less sharp in England than on this side of the Channel. Many of the English o castles of that epoch would be for us great manor houses because they do not have the defenses, that constitute a castle with us. The castles of Aydon (Northumberland) and of Stokesay (Shropshire) [2] would in France be classed among manor houses, and that of Aydon in particular is one of the most complete and largest that can be seen. It comprises a principal building of three stories with wings, courts anf a garden enclosed by good walls. This manor house is crenelated, but possesses neither tower nor keep. The strongest castles in England wit rare exceptions retain the appearance of a country house, which distinguishes them from our great feudal residences, such as Coucy, for example, which explains the internal state of the country after the 13 th century.

Note 1.p.302. Hist. du dioc. de Paris. Lebeuf. XIV.p.324.

Note 2.p.302. Dom. arch. of 13 th century. Chap. IV.

Several castles of Guienne, built under the domination of the English, although retaining in their details all the characteristics of the French architecture of the end of the 13 th and beginning of the 14 th centuries, present that peculiarity of recalling the arrangements of the great Anglo-Norman manor houses. To become assured of this, it suffices to look over t the excellent work on those edifices published by M. Leo Drouyn.[3] Square building with enclosures, absence of flanking towers, buildings pierced externally, lower courts enclosed by walls, outer ditches. Irregular plans like those of the Roman villa, services separate from each other and forming many str-

structures. The English have retained in the arrangement of the country houses, that they build today, those traditions of the middle ages, do not find them bad, and apply without difficulty those true principles of modern life. We freely recognize that the English are our masters in the matter of comfort (they invented the word), and we repeat in all tones, that the architecture of the middle ages cannot lend itself to our modern habits. There is one of those numerous contradictions in judgment, that we make in France in art matters.

Note 3.p.302. La Guienne militaire, etc. by Leo Drouyn.

Already in the castles of the middle ages is recognized that the different services occupy the proper places, assuming their relative importance without the architects being otherwise occupied with questions of symmetry. But in the castle military reasons often impose arrangements, that must oppose or modify certain habits of well-being (Art. Chateau); it is not so with the manor houses. There it is only necessary to satisfy the needs and tastes of the owner; the question of defense is accessory; the manor house is only a country house sufficiently enclosed to be protected from a sudden attack by some adventurers, and it does not pretend to resist a regular siege. Simple during the 12 th and 13 th centuries, like the habits of the landed proprietors of that time, the manor house then possesses only a hall with a cellar beneath and a small added apartment; about it are grouped some rural buildings, barns, stables, wine press, bakehouse, lodgings for guests or colonists, the whole enclosed by a wall or a deep ditch.

In the 14 th century the manor house extends and attempts to resemble a castle, has several stories, and the services become complicated. At the end of the 15 th century the manor house often assumes the importance of the castle, excepting the defenses consisting of numerous towers, advanced works and high curtains. Plessis-les-Tours, inhabited by Louis XI, was only a great manor house, and its real defense consisted of a thorough watch over the exterior, that kept away indiscreet and suspected persons. When artillery became a means of attack against which mediaeval fortifications were found powerless, manor houses arose in great numbers because men found daily the uselessness of costly defenses built in the preceding centuries. In the 16 th century many little castles demolished

their useless towers, pierced the curtains externally, and were thus converted into manor houses. Those modifications brought into France by the customs, by the centralization of power, by the weakening of feudalism, into country residences, modifications that tended to replace the castles by the manor house, had no reason to produce itself in England. In that c country the castle is only a strong place; the country habitation, from a very early epoch, assumes the appearance of the manor house, and still retains it today.

There no longer exist in France those manor houses of the 13 th and 14 th centuries, such as are still seen in England; the wars of the 15 th and 16 th centuries overthrew a great number of them,for those residences could not defend themselves against armed bodies. In the last century the love of novelty caused the destruction of a vast quantity of those country dwellings. Some of the most substantial were alone preserved, by approaching the defensive arrangements of the castles. As for open manor houses, and what would be country houses for us, it is hardly in some farm houses of Champagne, Burgundy, Ile-de-France, Laonnais, Soissonais and Beauvoisois, that one finds some traces, such as cellars, substructures and enclosures.

We shall describe several manor houses still erect, and will enter into some details relating to the constructors of those dwellings. Charlemagne caused the building of two palaces "of remarkable work," says Eginhard,[1] the first not far from Mentz and near the land of Ingelheim;[1] the other at Nimeguen on the Vahal.[2] After the example of the emperor and under the Carlovingians, the habitations constructed by the great proprietors adhered to the Roman villa. But as the feudal system was constituted, the country habitation was coverted into the strong place, and it was hardly in the 13 th century under the reign od Louis IX, that the royal power was strong enough to regulate the construction of the habitations of the landed proprietors. On that subject the Olim furnishes us with much information. We see that the parlement intervened to prevent the knights and squires from fortifying their residences.[3] Within the feudal organization several motives arrested the too great development of fortified habitations, even obliging the g great barons in certain cases to content themselves with manor houses. "Powerful lords often for certain fiefs held from

lords, that in the hierarchical order of society were much i inferior to them; thus the duke of Burgundy was a vassal of the bishop of Langres in regard to the fief of Chatillon. Th Those great vassals could then take their cases to the tribunals of those lords, when lawsuits arose, either on account of the fiefs held from them, or in regard to any misdemeanor committed on the territory of those fiefs. That jurisprudence w was too simple, too much conformed to the custom of the fiefs, never to have been contested. But the complainants, when they had as opponent one of the great barons of the realm, and for judge a lord unable to cause his decrees to be executed, and consequently to decide with independence, addressed themselves to the king's court, and demanded that the criminal be held to reply before it,[1] as a direct vassal of the crown."

Note 1.p.303. Vita Karoli imperator. Chapter 17.

Note 1.p.304. At 10 miles southwest of Mentz.

Note 2.p.304. The manor house of Ingelheim and that of Nimeguen were rebuilt in the form of castles by Frederic I. Ermoldus Nigellus gives the description of the palace of Ingelheim. Books IV and V. It resembled a Roman villa in general arrangements.

Note 3.p.304. Here is an example:- "Etienne de Beziac, squire, built a fortified house, as it is said on Mt. Avoie. The abbot of Cluny opposed it, claiming that this squire could n not build in that place on account of certain agreements made formerly between their predecessors, and also because it was detrimental to his church and the entire country; that was w why the abbot demanded the destruction of what he had built in that place, and that the squire should be enjoined to not build there henceforth. On the other hand, Etienne replied that the abbot should not be heard on that subject, and that his habitation should not be destroyed; he added that he had not erected a fortress, that he did not hold from the abbot, that from time immemorial he and his predecessors had possession of that mountain as of his "aleu", together with the warren and other dependances. In brief, having heard the reasons of the two parties, and having learned from the bailiff of M Macon, that this mountain was already very strong in itself, and that several nobles and other persons protested and opposed on their part, what had been built in that place, because

a (strong) house could cause the country great injury, it was decreed that the squire Etienne de Breziac could not erect a house of that sort on the mountain designated." (Arrestat in pallam. 1284. Arr. 8).

Note 1.p.305. Doc. ined. sur l'hist. de France. I series. hist. polit.

By that intervention of the king's parlement in suits between vassals, an intervention caused by the royal bailiffs, a great lord possessing a fief held from a less powerful lord could no longer erect on it one of those fortified habitations, which would have dominated the country; he was compelled to content himself with a simple manor house, to which it was well understood that he could give all the importance of an actual castle, if he so desired, but not as a strong p place. Also at that moment when feudalism was seriously attacked, i.e., in the reign of Louis IX, that were built so many great manor houses in France. These manor houses although not having the visible signs of the feudal habitation, i.e., fortified towers, curtains and keep, as fiefs possessed the feudal rights, rights of hunting among others, for we see that n nearly always warrens belonged to the manor houses; now the warren, as proved by M. Champanniere,[2] was the exclusive right to hunt over the lands of the vassals, and not the right of raising rabbits in certain places. But the decrees of parlement [3] had admitted in principle, that the right of establishing new tolls, new warrens and new fish ponds belonged to the king alone. Thus on the one hand, the king by his organ of the parlement opposed, as much as possible, the building of fortified castles, and on the other refused sanction to the rights dearest to the lords, hunting and tolls, when those rights had not been established by previous possession. Besides the acquisition of a fief did not convey the prerogatives of the nobility, and if commoners purchased a fief or a part of a fief, which frequently occurred after the 13 th century, they could not build a castle or fortified residence there; disputes often arose between a lord and his vassal relating t to the nature of the structure erected by the latter; many m manor houses pretended to resemble castles and to take the place of a defense, after the teme in particular when the ruined great barons were compelled to alienate their properties.

It was so that during the 14 th and 15 th centuries France was covered by manor houses, that could protect their occupants against the armed bands scattered over the territory, and that many houses of the proprietors of fiefs became posts sufficiently fortified and enclosed to disquiet the country, and add to the causes of disorder of that time.

Note 2.p.305. De la pripriete des eaux courantes. Paris. 1846. p. 88 to 97.

Note 3.p.305. On this subject see a drcree of 1317. Les Olim. Vol. III. part. 2.1317. an. 65.

Note 4.p.305. Vivarios or Viarios were enclosed or not, in which were raised small animals and particularly rabbits.

From the 13 th century the banks of the Garonne, Dordogne, Lot, Gers, Tarn and Aveyron, saw arise a great number of these enclosed manor houses suited for defense; indeed in those provinces the fiefs were much divided, and after the war of the Albigenses, the great barons of the ruined southern provinces were reduced to powerlessness. The soil was covered by proprietors nearly equal in power and wealth; the English domination, far from changing that state of affairs, on the contrary saw in it a promise of security for itself and of prosperity for the country.

Those enclosed manor houses in the Bordelais are designated by the name of "casteras", and are still very common.

Not far from Bordeaux, at the entrance of the Landes is a manor house that seems to belong to the first half of the 13 th century, and which retains traces of internal arrangement of great interest; this castera is that of S. Medard-en-Jalle. The Jalle is a stream that has its source at that place called head of the forest, and that runs into the Garonne.

The manor house of S. Medard is built on the right bank of the stream, which at that point widens and forms a marsh. A wide ditch surrounds this fortified habitation, whose plan we give at the level of the ground story (1). This plan is drawn square with four little towers at the angles. The doorway is at A and two slots open in each side of the ground story, whose soil is raised little above the level of the marsh. At the origin this square enclosure surrounded a wooden structure, whose fastenings are still seen on the internal walls. Instead of the two walls O O of a later epoch, there were four

great wooden posts, that supported the floor of the second s story, partitions and a half timber dividing wall. A wooden stairs permitted ascent to the second story. This ground story had no more than 8.7 ft. between floor and ceiling.

The second story (2) presents a very curious arrangement. It was a mezzanine for part of the area as proved; 1, by the fastenings of the joists and the trace of the door frames; 2, the narrow windows B B'B" are doubled in the height of the s story and are separated by lintels; 3, the great windows C C' C" occupy the entire height of the story, are wide and divided in width by a mullion. That mezzanine was of wood, supported by the lower posts and those at d d'. Further tha half timber partition supported the double roofs, as we shall see presently. A wooden stairs P allowed access to the mezzanine. The g great hall R had 14.1 ft. between floor and ceiling, and each mezzanine about 7.5 ft.; so that the floor above that great hall and that over the mezzanine, including the depth of beam and joists, rose to the level of the upper inner defensive gallery.

Indeed in calculating these heights:--

The mezzanine story	7.55	
Depth of floor	0.98	Total 17.06 ft.
Mezzanine story	7.55	
Depth of floor	0.98	
Height of great hall	14.11	
Beam and corbels	1.97	Total 17.06 ft.
Joists	0.98	

The screw stairs V ascended from the floor of the great hall to the defensive gallery protected by a crenelated parapet . I are fireplaces and K are cupboards. At L are outside privies with soil duct indicated on the plan of the ground story.

We give (3) a perspective of this manor house taken from the entrance side. The masonry is entire except the crenelated parapets, of which only fragments remain.[1] All woodwork has been burned and has left numerous traces. The roof was probably d divided into two, according to the habits of the constructors of that time, and contained lodgings of half timber work on the level of the defensive gallery, as indicated by our view. On the front four square holes arranged in the structure above the entrance were intended to receive a projecting defensive

gallery, to which one descended from the inner gallery. We ha-have presented one of the frames of this outer gallery set in place. This method consists in enclosing a wooden building by a fortified wall of stone, and is curious to observe, for we see it employed in many of those square keeps of the 1M th c century such as that of Loches, for example. It is to be pres-umed that the half timber work or rather the lower pposts must have been replaced, for in the 14 th or 15 th century were built the two walls shoun on the plan of the ground story.

Note 1.p.309. See Notice sur le castera pres de S. Medard-en-Jalle, by M. Dumont. 1839. (Recueil de l'academie royale de Bordeaux. Lecture of Feb. 21. 1839.

There still exists in Gironde a manor house of a later epoch (end of 13 th or beginning of 14 th centuries), that resembles in its arrangement that of S. Medard-en-Jalle, but in which m masonry has replaced the internal wooden partitions; this is the manor of Gamarsac; situated on quite a high point, it dom-inates the mouth of the Dordogne, and was formerly surrounded by ditches. The entrance of this manor house (4) was at C and was protected by an external gate placed at right angles to t the front wall. The door opened into a first hall D with sta-irs ascending from the bottom.[2] From that first hall one pas-sed into the three other rooms, originally pierced only by slots intended to strike the ditch. At G is an arch that bea-rs the partition built in the second story. This ground story could only serve as a storehouse for provisions, or as a ref-uge in time of war. The second story (see plan B) was design-ed for habitation. It is divided into five roomswith a very i ingeniously arranged central communication. Four of these rooms have fireplaces I. In room L opens a machicolation K,to cover the entrance doorway. From the rooms L and M one passes into the angle tower F containing the privies, and into the passa-ge furnished with slots that strike the ditch beside the ent-rance. Two roofs placed on the side walls and on the division wall cover this castera, which was crowned by machicolations with battlements on its four fronts. Slots pierced in the wa-tch towers defend the angles and flank the fronts. The rooms of the second story were lighted by narrow windows, now repla-ced by modern windows. This castera or manor house was an act-ual keep aud offered a very safe refuge. Fig. 5 gives the per-

perspective view of this fortified habitation, taken from the entrance side.[1]

Note 2.p.309. The tower E as well as the watch tower F were modified in the 15 th century; greater dimensions were given to them.

Note 1.p.311. These drawings were furnished to us by M. Alaux, architect at Bordeaux.

In England some manor houses of the 1. th century present arrangements nearly similar to these, notably that of Belsay (Northumberland). It is certain that these casteras were only the principal building of a group of rural structures surrounded by a wall or ditch; it was the habitation of the possessor of a fief. During the 14 th and 15 th centuries the manor houses adopt more frankly the arrangement of a country habitation, even in the southern provinces. Thus at Xaintrailles near Nerac, one still sees the quite entire remains of the m manor house where was born the celebrated Pothon. This manor house dates from the first years of the 15 th century (6). It consists of a bailey or lower court B now occupied by modern buildings. The road A leading to the manor house gives a entrance into that lower court by a first gate A'. Passing o over a ditch, one enters the internal court E by a carriage or a postern. From the passage from the gate one enters the room F, where was the doorkeeper or a guard at need. The great hall as at G and the kitchen at H with a door to the court. At the left is another great hall I into which one enters by passing over the lower landing of the graud stairway K. At L is a little keep wit external stairs M and internal screw s-stairs. The keep is only connected to the two main buildings by curtains, now enclosed within the recent structures. These two buildings are only defended by battlements at the base of the roof and by four watch turrets at the angles. The manor n house H is surrounded by gardens at the left side and behind the keep. This entirety is very well preserved, except the p part a b behind the grand stairway and the right hand building, that has been demolished, and whose foundateiosalone are now perceived. Fig. 7 gives a perspective view of the manor house Xaintrailla,taken from the gardens.[1]

Note 1.p.313. Part of this manor house was still occupied in 1843 by the marquis of Lusignas.

Near Nesles are still preserved the remains of a pretty manor house of the end of the 16 th century.[2] It was surrounded by a polygonal enclosure with ditch and defended gate. A rectangular tower, narrow and crowned by 4 machicolations served as an oratory in the ground story and watch tower at top; it further commanded the entrance. Modified in the 17 th century, and again more recently, the inhabited buildings have lost t their character, and only show plastered walls; they serve today for the cultivation of the surrounding lands. (8).

Note 2.p.313. The manor house of Launay, which was the residence of Sonteult.

In vignettes of manuscripts of the 15 th century, one sometimes sees manor houses very well drawn, that recall the arrangement of those just given in the last place, and they give a collection of structures grouped without symmetry, but according to the needs of the inhabitants.

Many of those manor houses of the beginning of the 15 th c century and tolerably defended were opened in the 16 th, their external walls were pierced by windows, and the ditches were partly filled and replaced by terraces.

Such is the manor house of Sedieres, a view of which is given (9). This manor house was built during the first years of the 15 th century, and is composed of the square tower A, the main building B and the porter's lodge C. The other buildings E were probably lower and enclosed the internal court D. In the 16 th century windows were pierced in the exterion of the old building; the interiors were rebuilt, and buildings now almost entirely demolished rose at E and F; the ditches were filled at the garden side. Thus those manor houses of the middle ages, whose first possessors had built fortified residences, were changed in the 16 th century into pleasure houses, of their ancient character only retaining machicolations that had become useless,and portions of the ditches before the doors.

The chateaus of Rambouillet, Nantouillet near Paris, Rochefoucauld in Angoumois, Villers-Cotterets and Compeigne, were only manor houses under the reign of Francis I, by reason of the work of adaptation executed to open them to the exterior and to take away their character as fortresses.

The 16 th century erected a quantity of manor houses of which ruins exist. We shall cite among others the manor house

of Ango near Dieppe built by the celebrated privateer captain about 1525. "He had acquired the beautiful lands of Varengeville," says M. Vitet in his excellent history of Dieppe,[1] "the ancient domain of the family of Longeuil; the beauty of the country, the vicinity of Dieppe, led him to demolish the old castle and build for himsel a manor house in modern style after his fancy. That is the manor house of which still remain some buildings converted into farm buildings, but which by an old custom, the inhabitants of the country know and designate only by the name of the chateau." This manor house had considerable extent, since Ango could receive king Francois I in it. But as we have already stated, the manor housesreplaced the castles in the 16 th century. Azay-le-Rideau, Meillant, Chenonceaux and Anet, by their arrangement and purpose belong to manor houses rather than to chateaus, and singularly approach the antique villa. The symmetrical chateau of the reign of L Louis XIV caused the last traces of the manor house to disappear, since from that epoch simple country houses have sought to copy on a small scale those ponderous and regular masses, that in France particularly distinguish the chateau of the e end of the 17 th century from all habitations of the preceding centuries. But there is in the arrangement of the great chateaus of the 17 th century, such as Richelieu, Coulommiers, M Maisons, Monceaux, Vaux, etc., a certain amplitude and dignity, that suits those princely habitations, and that reflects the broad existence of the lords of a powerful country, who did not need to shut themselves within their resdiences,like the barons of the middle ages; that amplitude and majesty being reduced to the proportions of the dwelling of a citizen served by two or three domestics became ridiculous. Therein our neighbors in England knew better how to keep the scale, and their little country houses are good today, the dwellings of private men with modest fortunes and tastes, and who prefer the internal convenience to the vain satisfaction of erecting a diminutive of a chateau.

Note 1.p.318. Histoire de Dieppe. Part IV. p. 451.

MARBRE. Marble.

Crystallized limestone, hard and receiving a polish. -- In France marble was little used during the middle ages; first

because that material is not very common, then because its use requires considerable expense. The Romanesque architects of the first times often robbed antique monuments of their columns and capitals to apply them to new buildings; even u under the first Carlovingians by a reminder of Roman traditions, they sometimes carved marble capitals, but those examples are rare. This hard material takes long to work and could not suit artists, who no longer had sufficient resources to complete works of that nature. But in the South of France, the use of marble did not cease until about the middle of the 14 th century, principally in the vicinity of the Pyrenees. There exist several cloisters in those southern provinces, whose columns and even capitals are of marble.(Art. Cloitre). Men also sometimes employed colored marbles as inlays during the 11 th, 12 th and 13 th centuries,[1] and for pavement, and white marble for altars, reredoses, tombs and statues. The system of construction adopted at the end of the 12 th century in France further did not lend itself to the use of marble, that even in Roman antiquity (except when it relates to isolated points of support like columns), was only applied as some form of facing.

Note 1.p.317. For example, at the cathedral of Lyons.

The poets and chroniclers of the middle ages do not fail to mention works of marble, marble palaces, stairs and chambers. Which proves that the use of that material was regarded as an extraordinary luxury. Abbots that rebuilt their monasteries during the 11 th and 12 th centuries, or contemporaries that related their actions, did not omit to mention numerous works in marble, that never existed. Those are very common hyperboles among those chroniclers. Thus it is said that Suger caused marble columns to be brought from Italy for the enclosure of the sanctuary of the abbey church of S. Denis; now those columns are of hard stone from the quarries near Pontoise. Common people also frequently give the name of marble to certain hard limestones, that take a polish, but which however do not have the qualities of marble.

When the sculptors of the middle ages desired to cut marble, they have done it to their honor; to be assured of this, it suffices to see at S. Denis quite a large number of statues of white marble from the 14 th and 15 th centuries, that are

of excellent work. (Art. Statuaire).

The museums of Toulouse and of Avignon also possess many r remains of marble monuments from the 12 th, 13 th, 14 th and 15 th centuries, of beautiful work.

MARCHE. Market.

A covered place of sale. (Art. Halle).

MARQUETERIE. Marquetry. (Art. Menuiserie).

MENEAU. Tracery. Mullion.

Seldom used in the singular number. -- This name is given to the mullions and compartments of stone, that divide the surface of a window into several open spaces, that are filled either by fixed glass, or by opening sashes, also glazed. (Art. Fenetre). In Italy, Spain and likewise in France, during the first centuries of the middle ages, the windows of public edifices were often without glass; lattices of stone, metal or wood, were then set in their openings to soften the light and to prevent the wind and rain from penetrating into interiors. When the use of glass became habitual about the 11 th century, the openings were filled with glass maintained by wrought iron cross-bars. But about the end of the 12 th century at the time of the adoption of the system of architecture called Gothic, the windows being enlarged, it was necessary to arrange in their open areas stone divisions to support the glass; for those iron armatures were difficult to make, flexible and did not offer sufficient resistance to the force of the wind. Besides, those wide and high openings, if left void, would have no happy effect; they did not give the scale of t the structure, and the architects of the lay school at the e end of the 12 th century possessed sufficiently the feeling of proportion not to leave great void surfaces without occupying them by stone compartments, that could recall their dimensions. These divisions are seen to appear about the first years of the 13 th century in Ile-de-France, Soissonais, Beauvoisis and Champagne. These first mullions are composed of stone and are built. Such are the mullions of the cathedral of Soissons and of the cathedral of Chartres. The tracery of the windows of the chapels of the choir of Notre Dame of Rheims,

although dating from about 1215, is still composed of courses or of voussoirs (Art. Fenetre, Figs. 13, 14, 15, 16, 17 and 18). But soon the lay school of the 13 th century made of the tracery actual stone sashes formed of mullions set on end and of perforated compartments cut from slabs more or less thick, according to the dimensions of the openings. In vaulted edifices, like the churches and great assembly halls, whose windows occupy all or nearly all the surface left under the side arches of the vaults, the tracery is at first composed of a central mullion with two pointed arches surmounted by a circle. Such are the upper windows of the choir and nave of the cathedral of Paris, rebuilt about 1225. (Art. Cathedrale, Figs. 3 and 4). Now the tracery of the upper windows of Notre Dame of Paris can be regarded as the first made in the manner of rigid stone sashes, between jambs and arches constructed of courses.

It is interesting to see how the architect introduced those stone sashes in the old windows of the 12 th century, and how the tracery was cut. The upper windows of the choir of Notre Dame of Paris had been constructed about 1170. They consisted (1), according to sketch A, of jambs with little columns on t the outside (see horizontal section B made on a b) surmounted by two equal concentric arches with a row of dentils added to the extrados. At D was the band covering the shed roof placed over the gallery, and at E the rose window opening beneath t that shed roof above the vaults of that gallery. (Art. Cathedrale, Figs. 3 and 4). The system was then new, of tracery allowing very wide windows to be filled by colored glass, and had so strongly charmed the bishops, chapters and their architects, that they did not hesitate to destroy the rose windows E, the old window sills J of the 12 th century, to replace t the shed roofs by terraces, to cut the jambs F, and to remove the inner arch of the opening. That being done, they cut in the remaining stones the little columns G inside and outside; inserted blocks H in the places left void b: removing the voussoirs of the rose window, as indicated by the hatched outline, placed the mullion I in the middle of the opening, and jointed on this mullion and on the recut jambs the upper stone sash composed of two arches and of a circle. The curvature of the arches of the original window was then changed, and between

the extrados of the stone sash and the intrados of the second arch of the 12 th century, left in place, was inserted the f filling K. The joints of this stone sash marked in our Fig., were cast with lead and iron dowels set as indicated by the detail L. It is to be presumed that the fear of the architects to see the arches of the old windows bend, weakened by l losing a row of voussoirs, determined them to give greater sharpness to the equal arches of the tracery. Each tracery is composed thus:- 1, of the little central column, whose section we give at m; 2, of the forked middle impost; 3, two lateral imposts; 4, two closers of the lower arches; 5, four lateral voussoirs; 6, the keystone of the circle and two upper closers, in all 13 pieces of stone for a window 32.8 ft. high by an average width of 11.2 ft. But the void spaces left between these stone divisions were still too large to be glazed without the aid of iron. A transverse rod passing through the springings of the arches at N and crossing the head of the c capital P was set in constructing the sashes. Bars O were fixed between the jambs and the central mullion and formed a series of rectangular panels; vertical bars R again served to diminish the width of the two openings and formed the border of the glass. In the circle 4 bars S also divided the void s surface of the circle. These bars were fixed in the circular sash. One will note that the joints of the tracery always radiated from the centres of the circle or of the pointed arches.

But already the windows of the chapels of the choir of the cathedral of Rheims, contemporaneous with those given below, possessed tracery constructed in courses, that in the upper circle constructed cusps intended to reduce the open area of those circles. (Art. Fenetre, Fig. 18). In this case as always, to Champagne are due the innovations in Gothic architecture. The upper windows of the nave of the choir of Notre Dame of Rheims, although built about the middle of the 13 th century, have sanctioned the principle adopted by the primitive a architects of that incomparable edifice. Those windows are further indicated in the sketch of Villard of Honnecourt before the resumption of the work on the cathedral in 1241, thus as a composition belonging to an earlier epoch. They consist of a central mullion supporting two pointed arches with a circle divided by cusps into 6 lobes (2). The tracery is represen-

reproduced at a larger scale than those of the chapels. The openings are not less than 7.5 ft, hence they were fitted w with strong iron armatures. The cusps of the circle are set in a groove, as indicated in section A made on a b. The rebate supporting the glass is made inside, as seen in the horizontal section B made across the central mullion, the exterior b being at E. The glass panels are held in the circle by means of keyed pins d fixed in the insides of the cusps. The iron armature of that circle is itself fixed on the inner face of the cusps. The section C of the two little arches have as generator an equilateral triangle, the centres of the arches b being taken at the imposts of the curves. One will also note that second row of little columns supports the round forming the principal member of the tracery, but that those rounds do not follow the curve of the great arch; so that the round of the circle penetrates the great bevel X, and that circle appears circumscribed by the archivolt, but independent of its profile, so that the tracery seems to be only a sash inserted and not forming part of the architecture, but the whole still being made with the structure. The system adopted by the primitive architect of the cathedral of Rheims, and scrupulously followed by his successors till the end of the 13 th century, was not the independent mode dated from 1240. Already at that epoch, they claimed to no longer leave such wide spaces for the glass panels. The windows occupying the entire width between the piers, a single mullion did no always suffice; they desired to divide these spaces when very wide, and instead of two spaces established four, so as no longer to have to glaze spaces over 3.3 to 4.3 ft. wide at most. But that extension of the principle presented difficulties; for nothing could serve as an example at that epoch, neither in antique nor Romanesque architecture, nor in oriental architecture. The architect that conceived the first plans of the cathedral of Amiens, Robert of Luzarches, but who saw arise only the lower p parts of the nave, had arranged the windows of the side aisles according to the system adopted for the windows of the cathedral of Rheims; a central mullion, two equilateral arches and a circle with cusps set in a groove.

His successors having to glaze the enormous upper windows of the nave, that are 19.7 ft. wide by 42.7 ft. high, thought

of filling those spaces with stone tracery sufficiently strong and close to be able to set the glass panels in its openings without having recourse to that mass of ironwork, that we see applied to the windows of the cathedral of Rheims. But they all started from the same principle; they established the principal skeleton according to the method adopted at Notre Dame of Rheims, i.e., composing it of central mullion supporting two equilateral arches with an upper rose window; but in those two great intervals left between the jambs of that central m mullion, they made a second stone sash, composed in the same manner; and a middle mullion supporting two equilateral arches and a circle. This system of crystallization, i.e., by infinite repetition of the accepted principle, we see rigorously applied from the end of the 13 th century in Gothic architecture, but it did not at first attain its logical results; there was groping, and there appeared difficulties in execution, which were but imperfectly solved. The upper windows of the nave of the cathedral of Amiens are certainly one of the first experiments, for their construction cannot be later than 1235. Those windows (3) [1] are composed, as everyone knows, of a central mullion built in high courses, of two dividing mullions of smaller section and composed of stones set on end, of two complete equilateral principal arches with a great upper rose window, of two complete equilateral arches resting on the dividing mullions with their secondary rose. Those secondary equilateral arches bear their round continuing the s section of the dividing mullions, and this member or round p penetrates the splays of the jambs and of the central mullion, as shown by the perspective sketch A. As for the secondary roses B and C, their section is independent and does not participate in the members that they penetrate. One will even observe that being troubled by the jointing, the constructor has placed the cusps of the rose B in a groove like those of the great central rose. (At E we give at double size the section of these secondary roses on a b.

Note 1.p.323. See the entirety of the composition of those windows in Art. Fenetre, Fig. 10..

At Amiens the constructors possessed only materials of quite moderate resistance and of rather small dimensions; they thus experienced difficulties in constructing those enormous trace-

traceries, and must multiply the joints to avoid too large p pieces of stone. Now if attention be paid to the jointing that we have accurately reproduced, one will see that in fact the blocks have only ordinary dimensions, and that the joints are traced in a manner to avoid ruptures to be feared in those w works of tracery. As it always happens, it is not the simplest means that first presents itself to the minds of those that invent. This tracery with its raised sections, cusps in grooves, certainly offers difficulties in drawing and cutting, of penetrations not easily taken into account by the stonecutters, of disford between the principal and secondary members, t thin and thick parts, breaks in the curves at the points I, f for example; yet already the architects had caused the round or member G to extend entirely around the archivolt, continuing the section of the little column H and penetrating the m member of the great rose tangentially.

This was an advance in drawing from the tracery of the windows of Notre Dame of Rheims. But however rapidly one proceeds, he does not arrive at simple methods and practical procedures without experiments. To give a drawing at reduced scale of t the open compartments of a window and a single section to suffice to make the drawing at full size was evidently the aim to which the architects must tend. It was essential to discover a method. It was also necessary to avoid disproportion between the openings, i.e., to distribute them in such manner, that they should not be too crowded or too far apart. It was essential (since the system was adopted of no longer having iron armatures of great areas) to make a network of stone equally close to avoid those heavy, complicated and expensive curvatures. The architects of the upper nave of the cathedral of Amiens must have perceived the disproportion existing between the roses of the tracery, the heaviness of the secondary equilateral arches enclosing the lower roses, the difficulty of cutting those penetrations of members of different sections. Thus erecting a little after the upper windows of the nave, those opened in the western wall of the transept, they had already made improvements in drawing the tracery of these windows.(4).

Raising the imposts of the archivolt above the capitals of the mullions, they could give a smaller diameter to the princ-

principal rose, finding between the small lower equilateral arches and the two secondary equilateral arlhes a wide space, that they filled with trefoils, which no longer gave a diminutive of the central rose. In the central rose instead of simple cusps, they conceived the cusps at A, which better fitted the void area and diminished the importance of the iron armature. Further, they added the cusps B to the lower equilateral arches. This general drawing i evidently better conceived than that given in Fig. 3; but also the work of the detailer and the stonecutter is simplified. One will observe in this drawing, that the cusps alone of the central rose are set in a groove (see section C made on a b); all other members are included in the general jointing. Further, a single section is the generatrix of all members; thus the central mullion is the section D E F. The secondary mullions are given by the d derived section G E H. The cusps of the lower equilateral arches adopt the section K E L. As for the section made on a d, it is given by D E M. By means of that combination, the axes alone of the principal rounds P and of the rounds or little s secondary columns S being drawn, and the section D E F with its derivatives being given, the entirety of the tracery was obtained without difficulty by the draftsman. There only remained besides that combination the cusps of the central rose. All the profiles of that section D E F revolve, save the exception admitted only for the extrados T of the secondary equilateral arches and of the central rose, which takes the simplified section D M D. One will also note, that in this drawing the jointing is infinitely more simple and natural than in the preceding drawing. Without difficulty the joints radiate from the centres of the equilateral arches and at the same time from the centres of the lobes. These joints were then always normal to the curves, avoiding sharp points and consequently the causes of breaks. Finally, the iron armatures are reduced to simple bars fitted with staples, and to some light secondary bars.

Yet in that ingenious combination, experiments are still a apparent, and no general method controls the starting point of the drawing. We shall see that the architects of the same edifice soon arrived at sure methods, to rules given by geometrical combinations.

The windows of the choir chapels of the cathedral of Amiens are contemporary with those of the S. Chapelle of Paris, and date from 1240 to 1245; now the tracery of these windows is drawn according to a very simple and very good geometrical p principle. It must be stated that this tracery consists of a single central mullion supporting the tracery beneath the ar-chivolt. (Art. chapelle, Figs. 39,40.

Let (5) at A be the horizontal section of one of those win-dows with its central mullion B. Let the lines B B′B″ be the axes of the central mullion and of the little columns of the jambs. One will first note that the same section is adopted for the central mullion and for the jambs. Let the line C D be the springing of the arch that must terminate the window. The space between the two axes E and F, half the width of the window, is divided into four equal parts E f, f G, G h, h F. From the point f, taking the half thickness of the column or round, that half thickness is laid off on the base line to f′. From the point h that half thickness is laid off to h′. Taking the length E h′, it is laid off on the base line to h″. On th that base h′ h″ is erected the equilateral triangle h′ h″ H. On the base f′h′is also erected the equilateral triangle I f′ h″, and from the apex H of the great equilateral triangle is drawn the little equilateral triangle H i′ i, similar to I f″ h′. Then taking the length e f″ and the apexes I f′h″ and H i i′ as centres, the trefoils are described. Taking the poin-ts h′ and h″ as centres of the length h″ O as radius, the g great arc O p is described. To find the centres of the two lower equilateral arches, from the points f′ and h′ are drawn two lines parallel to h′ I and f′I; these two parallels meet the lower arcs of the trefoil at l and l′. On these two lines, from l to m and from l′ to m′, one takes a width equal to the little column or round. From these two points m and m′ are dr drawn two parallels to m g′ and m′g; those two parallels meet the internal lines of the rounds at n and n′; hence the two triangles m n g′, m′ g n′ are equilateral, and taking the po-ints g and g′ as centres and the length g n′ as radius, one traces the lower equilateral arches. At T we have drawn half the tracery with the thickness of the mouldings. Thus all s sections normal to the curves give the generating section of the central mullion B.

The jointing is simple, logical and stable, for all sections are normal as indicated by the drawing T. Without experiments the round at the points of junction of the two curved figures always retains its same thickness, which is the most essential rule for drawing the openings of the tracery. From the middle of the 13 th century, the tracery is always drawn according to refined geometrical methods, at least in the edifices erected in Ile-de-France, Champagne and Picardy. Among this tracery, that whose design appears most complicated is often produced by a simple geometrical method presenting no difficulty to the draftsman. We shall furnish the proof. At first the architects of that epoch avoided tracery with different sections in the same window; they adopted a single section, even for the tracery of windows of four bays, like the windows of the abbey church of S. Denis (Art. Fenetre, Fig. 24). Therefore it is further only necessary to trace the compartments by means of the axial lines of the sections of the tracery. This principle also permits one to treat without difficulty windows with one, two, three or four mullions, to trace compartments at a small scale, following the geometrical method, and thus to permit drawing the details on the workyard without danger of errors.

The tracery of the windows of S. Urbain of Troyes, that date from the second half of the 13 th century (about 1260), is d drawn according to this principle, i.e., that with the drawing which we give here of one of those windows and a section of the mullion at full size, the details can be made for the cutting of the glass panels. That was a considerable advantage in a time when many monuments arose in the French provinces and even abroad, for drawings sent by our architects of the royal domain. The extraordinary influence that the style adopted by our lay school had acquired over the entire extent of the territory actually French, over a part of Germany and of Spain, was such that the architects had been compelled to seek methods of drawing, that were not subject to false interpretations.

In Art. Construction, p. 197 et seq., with regard to the c construction of the church of S. Nazaire of Carcassonne, we have shown that the most complicated combinations of lines c could easily be transmitted by the aid of drawings made at a

small scale; the superiority that should be given to us over our predecessors by six centuries by more extended knowledge of descriptive geometry, and so many other advantages, is however not such, that we could transmit as easily today the details of our architecture with entire confidence in the mode of interpreting them. Architecture is worthy to be regarded as an art, only as it leaves entire the brain of the artist, and that it can be drawn. When one comes to experiment during the execution and to erase, so to speak, on the monument just like erasing on paper, there cannot be a pretense of possessing architecture.[1] Such an epoch cannot show too much respect to artists, who know what they desire, and who combine an entire edifice in their heads before opening the workyards. Let us then examine the tracery of the windows of the choir of S. Urbain of Troyes. (6).

Note 1.p.329. There is no need here to recall how many times, even at Paris, that we have lately seen men remove and rebuild on the monuments themselves; this is a mode of seeking the good or the better, that is somewhat expensive. Formerly one tried it on paper; but once having commenced the execution, all parts held together and were conjoined, and thus could not be changed without its being possible to give serious reasons for those changes.

Let A B be the width of the window. On that width, that gives the axes of the rounds or little columns of the jambs having as section the half section of the mullion, is drawn the equilateral arch C D E, then the base C D of the two circular arcs circumscribe the equilateral triangle. Dividing this equilateral triangle by the axis E F and by two lines C G and D H passing through the middles of the lines D E and C E, the Fig. E K I L is obtained, in which we inscribe the circle whose centre is on the axis at M. Marking on the lines L C and L D two points M′ M″ at distances equal to the length L M, t two other circles are drawn with radii equal to that of the circle with centre at M. It is clear that those two circles are tangent and are inscribed in the great pointed arch. Then dividing the width A B into three equal parts A a, a b and b B, and bisecting each of these divisions, we erect verticals from the points N and O, like O P that cuts the circumference of t the circle M″ at P. From this point P with a radius equal to

b B we form the equilateral triangle P b S. Then we have the base R S of the tracery resting on the mullions. Taking the points b S as centres and the length b S as radius, we trace the three lower pointed arches; we seek on that base R S the centres T of the second middle pointed arch starting from the imposts a and b and being tangent to the two circumferences M′ M″. All these lines form the axes X of the tracery, whose section we have given at Y. The darker portion Z on that section Y gives the section of the cusps. The axis p of these c cusps is at a certain distance from the axis X and must not be confused wit that. To trace the cusps we then take that distance inside the interiors of the circumference of the circles and of the lower pointed arches. For the cusps of the circles, m being the point marked on the axis at the distance X f given by the section of the tracery, one divides the distance m M into two equal parts; from the middle point m′ and taking m′m as radius, we trace the cusps with four circular lobes. As for the cusps of the lower pointed arches, they are traced with the same radius; the centres of the lower branches being placed on the base line R S. The cusps of the space Q are likewise inscribed within an equilateral triangle. At A A we have traced at the scale of 1 : 20 the detail of the cusps of the circle with the circular iron armature fixed to the f four ends of the lobes and destined to support the glass. The jointing of the tracery is indicated by lines g, etc. At B B is given the detail of the capitals. This tracery that is only 3.8 ins. thick by 9.0 ins. deep, suffices to maintain t the glass in the windows, that are 14.4 ft. wide by 30.2 ft. high from sill to crown, and they also rest on a perforated gallery (Art. Construction, Fig. 103); they are cut in the f fine lias of Tonnerre and are well preserved. It would be impossible to combine a lighter sash of stone, better understood and more resistant with regard to its extreme slenderness.

The side arches of the vault exactly circumscribe the great pointed arches that served as centres for turning them; for these arches enter into grooves under those side arches, as indicated by the section X′. There is no need to say that the vertical mullions are in one piece each, and that the openings are cut in very large slabs of stone, as indicated by the jointing traced in Fig. 6.

About the end of the 13 th century and the beginning of the 14 th were employed methods still more precise and more rational. One will note in the preceding example, that there are s still certain lines left for trial; thus the inscribing of the upper circle, the generator of the other three, in the Fig. F K I L, can be obtained in practice only by seeking on the axis E F the centre M, by means of trials, the tangency of this circle with the lines G I and D H and the two arcs C E and DE only being known in advance by complex geometrical operations, that it would certainly be useless to make, the architects w were then brought to seek geometrical methods, that could always be demonstrated, and consequently whose trace was absolute. That result is remarkable in the part of the church of S. Nazaire of Carcassonne, which was erected at the beginning of the 14 th century. The equilateral triangle becomes in that e edifice the generator of all the compartments of the tracery. Let us take first the windows of the sanctuary of this church that are simplest, and that are divided only by a central mullion supporting the tracery. The generating trace is made on the axes of the little columns or rounds. Let (7) be one of those windows. The three vertical lines A A′A″ pass through the axes of the little columns, whose section is given at B. That axis is traced in a. The springings of the pointed arch being at C C′, on that base C C′ is erected the equilateral triangle C C′D, and taking C C′ as centre, there are traced the two arcs C D and C′D, which are always the axes of the r rounds given at a on the section B. Dividing the lines C D a and C′D into two equal parts, the dividing points d d′ and po-points D C C″c being taken as centres, we trace the three curvilinear inscribed equilaterals. Two verticals dropped from the two points d d″ divide the two arcs C c and c C′ into two equal segments. Then taking inside these arcs distances equal to the distance between the generating arcs a and the axes b of the secondary members of the tracery, whose section is at B, let this be e e′, the springing of the tracery being fixed at the level E; on that springing we seek the centre of the circular arc, that must pass through the points a and f; a c centre naturally obtained by drawing a line through the points e and f and erecting a perpendicular at the middle of that l line and as far as its intersection with the line of the level

E. Hence the arcs C′D, C″d, c d′, d d′, etcs, are regarded as principal members, and the arcs c C′, e f, e′f as secondary members, the centres of the cusps G are taken on the axes passing through the summits of the curvilinear triangles, as indicated by the dotted radii; those cusps are secondary members, i.e., their section is that given by the second generating section whose axis is at b. But the arcs C c and c C′ being themselves secondary, the axes of the cusps are tangent to these arcs, as seen at g. As for the lower cusps h, they a are tertiary and take the section h′, a subdivision of the g generating section B. The capitals of the arches are placed on the level C C′.

The trace F of one half of the tracery at the scale of 1:25 explains the trace of that sketch so as to make understood the sections of all the members. Frequently as in the present case, the section of the extrados M is simplified and gives the section N, but that arrangement is rare; from the end of the 13 th century the sections are uniform at the intrados as at the extrados of the arches of the tracery. On the drawing is given the section of the side arch, that exactly encloses the arch of the tracery, serving it then as centre. The tracery of these windows is in happy proportions; from the sill to the springings E of the lower arches the little columns are 25.3 ft high, and are composed of two or three pieces.

The compartments of the upper tracery generated by equilateral triangles lend themselves perfectly to the system of tracery arranged in three bays, quite generally adopted in the 14 th century. Since the windows were ornamented by stained glass, it was desired to have a middle motive; the windows in two or four bays were less favorable for the painting of subjects than the division into three. There was then an understanding between the architect and the glass painter. In the great same church of S. Nazaire the great eastern windows of the transept are indeed divided into three bays by means of two mullions; the compartments surmounting these mullions, although differing, all proceed by combenations given by the e equilateral triangle. Here is one of those windows (8).

It is understood that from the middle of the 13 th century the compartments are traced by taking the axes of the little columns or rounds. Then let a a′ be the axes of these little

little columns whose section is given at A, with its decomposition into secondary and tertiary members, the line b being the axis of the secondary member and c that of the tertiary member. The springing of the side arch being at B, on the base line B B′ is erected the equilateral triangle B B′C. The points B B′ are the centres of the principal arcs B C and B′C. From the same point B′ and the point D, taking B D as radius, we describe the two arcs B′e and D e; from the point e as centre we describe the third arc D B′, but reducing the radius by the distance between the two axes A and b. It is clear that the centre e is found on the side B′C of the great equilateral triangle. Taking the points e and C as centres, we trace the upper curvilinear triangle. From the point f of the intersection of the base with the axis of the window and always t taking the distance a a′ as radius, we obtain points of intersection g, that are the centres of the middle pointed arch fg. Those are the axes of the principal members of the compartment, those with the largest section A. It is now necessary to trace the compartments, whose section is given on the secondary axis b. Taking the points C and e as centres, and having divided the arc C e into two equal parts, the lengths e i and C i give us the radii of the three arcs forming the concave curvilinear triangle inside the upper convex curvilinear triangle. Having erected the two verticals l l′ a a distance from the axes a a′ equal to the distance existing between the great axis A a and the secondary axis b, from the point n and taking the distance l l′ as radius, we obtain the points o o′, that are the centres of the lower arcs o n and O′ n. Always observing the distance between the two axes A and b of the section, we trace the middle trefoil, whose centres are at the angles of an equilateral triangle; then on the line of the level o o′ prolonged, we erect the lower central pointed arch tangent to the lobes of the trefoil. All these members belong to the secondary section with axis at b. The cusps, the little trefoils and the subdivisions traced in P belong to the tertiary section c. At R is represented half the tracery with all its members, a according to the thickness of each section, obtained by laying off to the right and left half the thickness of these sections. At S we represent one of the capitals s of the mullions and at T the pin through the iron bars placed at the springing of

the tracery, that are designed to maintain in their plane both the vertical columns and the compartments. These pins and all the joints of the stonework are cast in lead, a precaution becoming necessary from the time that the section of the mullions was reduced to a very small area. If one desires to devote some attention to the arrangement of that jointing, he will note t that the voids left at the middle of slabs of great dimensions are strengthened by subdivisions of trefoils and cusps, which add to the stability of this tracery. Those architects of the French Gothic school are terrible logicians, and the composition of the tracery of their great windows is a new proof of it.

Thus for example, those cusps H that are seen to appear about the middle of the 13 th century in Ile-de-France and at first at the S. Chapelle of Paris, those cusps regarded as a decoration and charm, were primitimely indicated by a need of strength. Every time that inconvenience results from a form adopted, one seeks and at once finds a means to remedy it, and that means becomes a motive of decoration. One sees in Fig. 8 that the branch K is isolated, and that the least settlement or an unequal pressure could break it at L: now that branch is strengthened by means of the cusp P forming an angle outside it. It is clear that the trefoils X, inscribed in the triangles opened in the largest pieces of the stone, give great strength to the branches of these triangles. Likewise the cusps V of the branches of the upper curvilinear triangles and those at N of the three right angle projections singularly add to t the resistance of these parts of the stonework. One does nothing different today, when he gives greater strength to cast iron members, for example, without sensibly increasing their weight; but it is true that it is desired to regard those innovations as due to modern science.

While rendering all justice to our time, we may however be permitted to restore to each epoch what belongs to it in fact; one is indeed compelled, when he desires to study with attention the composition of these stone traceries, occupying considerable areas relatively to those given by preceding and modern methods of architecture, are traced, combined and j jointed in a manner to present the least voids and to offer the greatest resistance possible. By drawing the principal members and the sections of the joints, all the weights are tran-

transferred on the vertical mullions, but chiefly to the jambs; as for the open panels, they are made rigid as solid slabs by means of those tertiary stiffenings, such as trefoils and cusps. These com inations must have been good, since most of our great Gothic edifices have retained their tracery, and when they have suffered deterioration, it is easy to restore or r replace them, just as one replaces the iron or wooden sash. T The stone tracery even has this advantage, that it can be repaired in part, if there are some breaks, while the sash of wood or iron, once deformed, must be renewed.

Let us add that this stone tracery glass of enormous weight and the iron armature destined to attach it. Only considering those architectural members from the point of view of the effect produced, they appear to us to form designs of agreeable appearance, reassuring the eye and happily composed. Into Ile-de-France it is always necessary to go to seek the best examples of this architecture, at the moment when it develops, to arrive at formulas. One finds in that school the purest and most classical art of the middle ages, a sobriety and an application of correct principles, obtained by the aid of the simplest methods, a refinement in proportions, in the choice of profiles, that leave in the second rank the works of the other provinces.[1] We give (9) one of the windows of the chapels of the choir of Notre Dame of Paris, erected at the same time as the choir of the church S. Nazaire of Carcassonne, i. e., about 1320.

Note 1.p.337. It should not be forgotten that the construction of the choir of church S. Nazaire of Carcassonne is due to an architect of the royal domain.

Here is seen the absence of all complex combination; it is always the design of the tracery of the windows of the S. Chapelle of Paris, but made lighter. These windows are also divided in four bays by means of a central mullion, whose section is given by the axis A, and two secondary mullions, whose section is derived from the principal and as given by the axis b. Let a and a' be the axes of the principal section A. From the point B, taking a'a" as radius, is described the arc concentric with the side arch C B. Then B C is the side of an e equilateral triangle. From the same point B and from the point I at the middle of the base of the triangle, taking B L as r

radius, we trace the arcs B E. Now B E is equal to E C. The upper circle is traced tangent to the arcs B C and I E. These are the axes of the principal members, those with section given by the profile whose axis is A. Laying off inside the window and from the points a a′ a distance equal to the distance between the axes A and b to e e′, dividing the base line e e′ into two equal parts, taking e f as radius, we trace the lower arches e f g, f e′g′, then the under secondary arch concentric with the pointed arch I B F. Taking toward the interior of this circle and of the lower arches a distance equal to the distance between the axis b of the secondary section and the axis c of the tertiary section, we trace the axes of the cusps.

The drawing of this tracery is then easily made, the composition is happy and clear, stable and with solid jointing, as one can see at G. At K is given the section of the jamb h supporting the side arch of the vault forming the external archivolt. At L is given the profile of the sill with outside at l with the penetration of the bases. The sketch m gives the horizontal projection of the abacuses of the capitals, and that at n is the horizontal projection of the bases. Here the function of the cusps is evident. These cusps i give great additional strength to the principal and secondary branches of the arches, and one sees how they are skilfully arranged not to interfere with the cuts a the joints. The central and the two secondary mullions are each of a single piece; as for the upper tracery, it is composed of only 15 pieces, and still these windows are 13.1 ft. wide by about 14.8 ft. high below the c crown inside.

Once the logical principle is admitted in the construction of the tracery as in the other members of Gothic architecture, architects did not stop. Soon they entirely renounced the generating sections, secondary and tertiary; they adopted a single section for all members of the tracery, except the cusps that are thinner. About the end of the 14 th century men already even seek to avoid pointed arches. The tracery is composed only of curves and reverse curves, so as to no longer form a network of uniform resistance. That was logical in theory; in practice those forms were less satisfactory.

To not charge this Article, already quite extended, with t too great a number of examples, we shall study the tracery a

adopted in the 15 th century, and in the composition of which one perceives that tendency of the constructors of that epoch to further only take account of logic, often at the cost of t the style of the apparent simplicity.

Then in the composition of tracery, architects seek to transform all forces and loads into vertical pressures. Let (10) be one of those windows of the 15 th century.[1] The section of t the three mullions of those windows is the same (see detail A), it is likewise reproduced in the tracery; the cusps alone are thinner and take the section B. By means of the great reverse curves of the two principal divisions, the loads are grought to the central mullion C and the jambs D. A part of these loads is even thrown on the intermediate mullions E by the reverse curves a and by those at b. The combinations of these curves and revesse curves show well the aim that the constructor proposed to attain, viz:- tracery forming a network whose meshes are resolved into vertical pressures, a general system of stiffening and reinforcement at all weak points by the cusps. For example, one understands that the curve c would break under the least pressure, if it were not strengthened by the c cust d. The bars e destined to maintain the panels of glass a also come to add strength to that given by the combination of the stone tracery.

Note 1.p.339. That given here comes from the choir of the c church of Eu, in which the architecture of the middle of the 15 th century is pure and wisely understood.

If one is willing to examine this tracery with attention, he will recognize that all the weak points, that must suffer the strongest pressures are stayed or stiffened by curves that t tend to make all the members stable; that these curves are t traced by reason of the variable direction of the pressures, so as to decompose those that are oblique, and change them to loads acting vertically; that the joints of the stonework are cut perpendicular to the direction of those pressures, so as to avoid weak joints subject to slip or to cause breaks. We do not have a very strong taste for this kind of architecture, but it is impossible for us not to recognize there the work of very experienced and sagacious constructors, even logical to excess, among whom caprice or chance has not taken root. When the abuse of a principle leads to such conceptions, it

is necessary to deplore the abuse, but it is essential to equitably state the value of the principle, and to attempt to d derive benefit by avoiding that excess. These men knew thoroughly the resources of their art, doing nothing unless guided by their reason. It does not pertain to us today to cast a stone at them, we that possess varied and excellent materials, and do not know how to use them, who exhibit insufficiency, when it concerns this sort of architecture. In this last example, the vertical mullions are each of a single piece from the sill to the springings of the curves. The bar G passes through the heads of these mullions and maintains the imposts of the tracery by means of bone pins 3/8 or 3/4 inch. Wires maintaining the glass panels entered the grooves I. The bars and rods as well as the dividing bars e have staples and keys. The architects of the 15 th century trusted so much to combinations of their tracery, that they often cut it in semi-hard stone, for example from the royal layer. It is also necessary to state, that they gave that a section relatively greater than that adopted for the tracery of the 14 th century, which is always more delicate. Those compartments of the tracery were retained until about the middle of the 16 th century. Yet at the e epoch of the Renaissance some attempts were made to place the tracery in harmony with the new architectural forms in vogue at that epoch. Witness certain tracery of the church of La Ferte-Bernard, which presents the most singular mixture of t the traditions of the middle ages and the reminiscences of Ro Roman antiquity. One would believe that he sees the arabesques of Pompeii executed in stone.

Note 1.p.341. From the 15 th century the constructors that had occasion to find how those iron pins swelled by oxidation, and were injurious to the stonework by making it split, replaced these metal pins by pins of mutton bones or of staghorn. The latter have retained all their hardness.

Here (11) is one of these combinations. The window is divided by two vertical mullions G, its axis being at M. The stone designer here has not sought wise joints for assembling the tracery. That actually consists only of three perforated and superposed lintels, whose beds are seen at L L′ L″, the branches O of the arch forming parts of these lintels. One also r recognizes that the architect by the arrangement of the arab-

arabesques wished to give strength to the weak points of the openings. The little figures and the scrolls only exist outside the glass, the glass panels being inserted in the principal compartments. Even the little column K has only half the thickness of the tracery and exists only on the exterior. At A is traced the section on a b and at B is the section on c d. The most delicate portion of that tracery is scarcely more t than an external decoration, that nowise supports the glass panels, but which still gives a little more stability to the work. This tracery produces a very good effect and is executed with delicacy and remarkable perfection. The rampant soffits under the cornices of the pediments are ornamented by d delicate engraving. The system of lintels or of perforated c courses adopted here could only be suited to quite narrow windows, since it forbids vertical joints. In the same church t the tracery of the windows having three mullions and four bays are combined in the mode of those before given, Fig. 10.

The windows of civil architecture also have mullions, when they were too wide for it to be possible to close them with a single sash (Art. Fenetre, Figs. 29, 31, 32, 33 35, 36, 37, 38, 40, 41, 42). Until the end of the 13 th century, these m mullions habitually consisted only of a little column relieving the lintel. The architects displayed a certain luxury of sculpture in the tracery of palaces, and sometimes even ornamented their shafts by figures. We have discovered at Sens a very beautiful mullion of this kind, which dates from the 12 th century (12).[1] The statuette attached to the column with octagonal section forming the body of the mullion represents geometry or architecture; it holds the great compasses of a detailer. At A is traced the section of the mullion made on a b, at B is the side of the mullion with the projection at the back intended to receive the bolts. In the section A we have not indicated the section of the figure by hatching, in order to show that of the little column in whose shaft was e engaged the statue. On the lower part of the mullions of the upper windows of the cathedral of Nevers, on the exterior one also notes statues attached to the shafts of the little central columns.

Note 1.p.343. This little column, which serves as a window mullion, is now placed in one of the windows of the ground a

story of the hall of the synod of Sens.

At the epoch of the Renaissance, one also sees mullions in the form of caryatides, or of pilasters surrounded by busts. It was scarcely until the reign of Louis XIV, that tracery was definitely renounced; men still employed it at the beginning of the 17 th century to maintain the closures of window openings. The internal windows of the court of the Louvre were originally fillet with stone mullions of monumental appearance, which gave the name of ladder to those great openings. Those mullions are now replaced by wooden muntins with imposts also of wood, that are scarcely in harmony wit the edifice, which it is nece sary to repaint every ten years, and to renew when they dacay, i.e., two or three times in a centurw. M Men say that this is more according to the rules of good architecture; why? We should be much embarrassed to say why.

MENUISERIE. Joinery. Woodwork. Cabinet Work.

If the peoples of the North are particularly apt in making works in carpentry, they are no less skilful in giving to wood those forms both delicate, light and stable, that constitute joinery. The art of joinery is further only a branch, derived from the art of the carpenters in the first centuries of the middle ages; the means of execution are the same.

The art of joinery is clearly distinguished from the art of carpentry, when one commences to employ for sawing, cutting and polishing wood very perfect tools. The invention of the saw dates back to a high antiquity; the ancients knew the plane, the short and the long jointer. Still until in the 13 th century were often employed for joinery riven woods, wrought by the chisel and the gouge without the aid of the plane.

There remain to us only a very small number of objects in joinery preceding the 13 th century, and in the assemblage those fragments muc resemble carpentry works executed at a small scale. But from the 13 th centurw the art of joinery ta takes a great flight, possesses its special rules, and arrives at a remarkable degree of perfection. The works in joinery that remain to us from the 14 th and 15 th centuries are often masterpieces in combination, execution and drawing. The traditions of this art retained until the 17 th century result from:- 1, a perfect knowledge of wood; 2, from a sagacious p

principle of derign; 3, from a judicious use of the material in accordance with its special properties.

As in every system of construction, the mateeial employed in joinery must determine the procedures of assembling and i impose the forms; now wood is a material posse sing special properties, that must be taken into account in the combination of works in joinery, just as in the combination of works in carpentry; the artizans of the middle ages did not wander from this true principle. The knowledge of woods is one of t the conditions imposed on the joiner; that knowledge being acquired, it is necessary to know how tc employ them according to their texture and strength. The wood that best lends itself to works in joinery is oak, because of its rigidity, the fineness of its grain, its uniform hardness, its durability and its beauty. So during the middle ages at least in France, oak was exclusively employed in the joinery of buildings.

To be employed in joinery, oak must be perfectly dry, i.e. must have been sawn at least six years. If we examine joinery works of the 13 th, 14 th and 15 th centuries, we shall indeed observe, that the wood has not sprung, that it has remained in its connections, and tha it presents no cracks. This wood after sawing was at first left in damp places and even in water, then piled in open sheds under dry shelters, frequently turned and sometimes subjected to the action of smoke.[1]

Note 1.p.346. Thus was prepared the wood, that served for making the stalls of the cathedral of Auch. This wood has acquired the appearance of Florentine bronze.

The joiners of the middle ages did not use too old wood, t that is subject to crack and spot. They caused to be sawn oaks of 200 to 300 years, i.e., trunks with a diameter at 9.8 ft. above ground that varied from 2.3 to 3.3 ft. inside the sapwood. These trunks were sawn according to different methods, but always taking into account as much as possible the texture of the wood. A trunk of oak that dries cracks according tc sketch - (O), which is easy to explain. The concentric layers are harder and more compact as they approach the centre, more porous as they approach the circumference. Thus these layers contain more water as they have a greater radius. When the wood dries, the external layers shrink more than the inner ones; there result splits or cracks, all radiating from the

heart of the trunk. If the wood is sawn without regard to this effect of drying, the sawn planks crack or buckle; they are sensible to all variations of temperature. On the contrary if this sawing be done in the natural direction of the cracks, the planks shrink in width, but can neither split nor buckle, i.e., curve in the direction of the sawing. Oak is formed of a series of layers like all woods, but these layers are connected by a kind of natural dowels, that make it solid; these dowels are termed medullary rays and radiate from the centre of the trunk. If then the sawing be done as indicated in the quarter B of the drawing, it is done in the best conditions, it is what is termed quarter-sawn (parallel to the medullary rays). This mode of sawing is lengthy and loses many triangular strips that are merely laths. The best mode of sawing after this is indicated on the quarter D, then that sketched on the quarter E. As for joists and timbers, the most economical sawing is that sketched on F. The medullary rays of oak not only give stiffness to planks sawn radially, but also present surfaces with a silky and watered appearance, that adds much to the beauty of the wood. Quarter-sawn oak is then best for joinery.[1]

Note 1.p.347. A quality that we now call Holland oak, and that is still in great part furnished by Champagne. Indeed much wood for joinery that comes to us from Holland is purchased by Dutch merchants in the forests above Rheims. The mode of sawing our woods makes us dependent on the Dutch. In fact the Dutch saw wood radially, i.e., they make the saw-cuts as much as possible always tending toward the centre of the tree, as practised in the middle ages and as still done by the rivers of stakes (On that subject see Traite de l'evoluation de la menuiserie, by A Boileau and F Bellot. Paris. 1847. p.48 et seq.; also Hassenfratz, Theorie des bois. Paris. 1804.p.133).

Although joiners employed skin glue and cheese glue, yet the solidity of the work first of all depended on the arrangement of connections by dovetails or dowels.

To join boards men used only quite late (about the 15 th century) rebates or tongues. They were connected by dovetails let into the wood (1),as seen at A; by strips halved and pinned as at B; by dovetail bars entirely sunk, or by tenons D of hard wood or even of iron. These are elementary combinations

that have been employed in all times. Indeed works in wood f from Egyptian antiquity are made by these procedures. On the edges of the boards is placed a coat of cheese glue that causes the boards or planks to adhere together. By means of a rounded scraper the visible surface is polished and painted, or ornaments or figures are inlaid to a slight depth. According to these processes ar made the pine doors of the cathedral of Puy-en-Velay, that date from the 11 th century. These ornaments are slightly carved in relief and themselves as well a as the grounds are covered by paintings on a trace of lead o oxide (minium).[1]

Note 1.p.348. Much of the old joinery retains traces of a coating with red lead, and that coating has contributed singularly to their preservation. This process was renewed a dozen years since by us and gives excellent results. It is generally adopted today. (See in regard to the joinery and polishing of boards the work of the monk Theophilus. Diversorum artium schedula. Book I. Chapter 17).

Two principal conditions seem to have been imposed on the works of joinery of the middle ages; economy of material and the greatest possible strength left to the wood at the joints. -- Economy of the material in that reinforcements are avoided when they could not be included within the squared timber; f for example in that panels never have more than the width of a board, i.e., at most 8.7 ins.; the muntins and cross-bars (stiles and rails) at most 3.2 ins. for ordinary works.--- The greatest possible strength is left to the wood at the joints, in that chamfers, reductions and mouldings stop where a joint is necessary. The observation of these two conditions gives a particular character to the joinery. If the material be economized, if it be employed in accordance with its properties, the workmanship is lavished, as if to emphasize the precious properties of the wood; for it should not be forgotten that during the middle ages the workmanship is always according to the value of the material; it is superior to that but is in a relative proportion.

The joiners of the middle ages took into account the value of the wood, just as the stonecutters took into account the value of the stone. There is a just idea, the true principle and a feeling of economy that imposes attention and study wi-

without injury to the art, for it is art. Those artizans thought that a material so precious as wood, that grows slowly a and requires long preparation to be definitely placed in the work, merits that it should not be wasted , and that the idea of its value is given by the care with which it is wrought. Those artizans did not give to joinery of pine, larch or fir, the forms permitted by the use of oak or walnut. Observing t the special qualities of the different species, they held to lightness combined with solidity, which is the first law of joinery, as we have already stated. consequentlw it would have never occurred to them in thought to imitate in joinery t the forms proper for stone; they never applied to joinery great curves that require considerable loss and require wood to be cut across the grain. All their combinations are based on the straight line, at least for the members. The study of this art, so greatly out of its path today, is then interesting; for with a system of construction very restricted, dimensions comprised in those of the wood uniformly sawn, those artizans succeeded in inventing the most varied and most ingenious combinations without ever being stopped by the difficulties presented by those combinations.

It is necessary for us to classify the works of joinery by kinds, so as to place order in this Article. We shall commence with those simplest in principle, with grilles, i.e., assemblages of pieces of wood of equal sizes, forming open closures in a single plane, in brief, grilles.

CLOTURES; CLAIRE-VOIES; CLOTETS; LAMBRIS.

Grilles, Sashes, Panels, Wainscot, Doors.

Here (2) is one of those wooden grilles as seen in the cathedral of Basle and in some churches of the provinces of the East. From a simple lattice of timbers halved together the j joiner came to make a grille of monumental appearance. The p principle stated above, that consists in leaving the wood all its strength at the joints is scrupulously observed; but between those joints at the openings the workman has used chamfers that form a decoration and take from that so simple a combination the rude appearance, that it would have if the pieces had remained square.[1]

Note 1.p.350. This grille retains forms belonging to the Romanesque epoch, although we do not believe it to have been made

before the 11 th century.

Here also (3) is an example of a framework forming a solid wainscot. The muntins and rails are the same and halved together, chamfered between the join s. The square openings left in the framework are filled by small panels simply set in the rebates like panels in a frame. (See section A).[2]

Note 2.p.350. From the city holl ot Ghent.(15 th century).

This sort of wooder grille was much used in the middle ages in castles and houses; frequently the great halls were divided by grilles of this kind, movable and that were placed when it was desired to obtein temporary divisions. In winter tapestries were suspended on these grilles; in summer they remained open. These movable divisions termed "clotets" were often very richly ornamented, having open panels and formed interlacings, the members ingeniously assembled, always by halving. For do not forget that the dominant character in French joinery of the middle ages is to be assembled, to retain a logical structure in perfect accordance with the form. There exist in Italy, Spain and even in the Orient joinery works of charming appearance, that attract by their excessive richness aud complex combination; but when one attentively examines the construction of those works, he soon perceives that this structure nowise accords with the appearance. The lightness is only external, the construction is of the rudest; for example, such is that seen in the Arab joinery of Spain, in a facing of mouldings mitered and nailed on a ground of boards placed beside each other rather than a sembled; such are the carved works glued on and applied on each other in a charming design, b but that decoration not according at all with true construction; and as one can observe in certain cabinet works of Italy and even in Germany of the middle ages, there are actual logs of wood connected by dowels, across which run mouldings, reliefs and ornaments, cut in the solid wood, just as in a block of marble. The mouldings are cut across the grain, the joints fall in the middle of a relief, no matter. Between the use of the material and the mode of ornamenting is no harmony or connection; the joiner and the artist are two men that work separately after each other. The joiner is merely an assembler of blocks; the artist is only a sculptor caring nothing for the nature of the material supplied to him. certainly those works

can be very beautiful from the point of view of the art of the sculptor, bu one cannot regard them as joinery. Why is it necessary for us to explain thus and to claim those qualities so truly French? Why are they scorned and forgotten? Those w works in wood of the Arabs and orientals have at least retained the traditional form of actual joineey, and if the artizans do not understand them, and no longer know how to apply t the construction, at least they respect the appearance; but one cannot say as much of Italian joinery, nor of that made in France since the 17 th century in imitation, and contrary to our eminently logical spirit.[1]

Note 1.p.352. We have frequently been called to remove joinery of the 17 th and 18 th centuries. One cannot understand how sculpture, often so delicate, and charming ornamentation, could be allied to construction so crude and unreasonable. T The beautiful stalls of Notre Dame of Paris, that date from the beginniug of the last century (18 th), are an example of that combination of barbarous means masked under the richest appearance.

Here (4) is one of those grilles of fir such as one still sees in the provinces of the East and on the vignettes of m manuscripts or paintings of the 15 th century.[2] The system consists of tringles of fir pieces 1.6 ins. square. On the muntins A are halved the pieces B. On these the pieces C, D and E; on these last the muntins, all being halved. The entire work is maintained in the frame G H I made of pieces 3.2 ins. thick by 3.7 ins. wide. At each halved joint is a soft iron bin K with two washers and riveted. On the front of each hexagon the corners are chamfered as indicated by the detail L, and in the open triaugles M, the edges of the triangles are also notched to form stars with six points, composed of two intersectiug equilateral triangles. One sees here that if the principle is simple and the material is common, the workmanship assumes a certain importance. At N we have given a section of the grille made on a b, aud at P is a perspective detail of the portion O taken apart. It is unnecessary to emphasize the solidity and perfect rigidity of this light lattice, whose effect is very brilliant. This sort of joinery works were nearly always painted in light colors enhanced by brown or black lines. Thus in the example given here the grounds being white,

the chamfer of the hexagons are reddish brown, as well as the three notches of the stars; the latter were also bordered by a thin black line. The washers and iron rivets were also painted black.

Note 2.p.352. What is here given was drawn by us at Luxell.

We could multiply these examples, but members of the trade will appreciate the entire system to be derived from these combinations without its being necessary to emphasize it.

In French joinery of the 14 th century are certain works t that indeed have some resemblance to the works of the orientals mentioned above, but whose structure however is more reasonable. Those enclosures, barriers and wainscots were simply formed of joined boards, rebated in a frame; to prevent the boards from bending and buckling as much as to decorate the plane surfaces, at least on one side, the joiner placed thereon a lattice of light pieces halved together, and forming g geometrical combinations more or less complicated. The flat surface of the boards was even frequently carved in low relief (since the sculpture was obtained in the thickness of these boards) in the compartments formed by the lattice.

Here (5) is an example of those works of joinery. The joints of the boards 12.6 ins. wide,are marked on our drawing. T The lattice is framed at its ends into the members of the frame, as indicated at a (see detail A) and is nailed to the b boards at each intersection, thus forming a perfectly rigid surface, that prevents the warping of this ground. This lattice is halved at the joints with dovetails at the mouldings as shown at b. The section C gives at c the thickness of the board and at d that of the lattice.[1] A balustrade of little turned columns surmounted the cap D, at certain distances p posts E maintain the whole. At F we give the profile of this upper cap f; at G is the profile of the rail g, aud at h is the profile of the lower rail h. We shall see at once the l leaves of the door of the church of Gannat, combined on the same principle.

Note 1.p.354. This work of joinery existed in fragments in the cathedral of Perpignan in 1834, and served as a wainscot in chapel S. Jean. It was of fir.

One will understand how strips of wood attached to boards and intersecting in all directions must maintain them in their

plane. However this system is exceptional in the joinery works of the middle ages in that we do not find the panels inserted in rebates, but as a simple ground on which is mailed a wooden network; this grille is not only applied decoration, but is composed of pieces assembled together and holds it self. From the 13 th century were fashioned in France works of joinery in which the system of panels inserted in rebates was a adopted; but then generally with tongues and grooves.

We give (6) one of those panels, shown in front at A, in s section at B, and in horizontal section at B′. This system m merits some attention. A wainscot is composed of muntins and rails, between which are grooved in panels. The end muntins forming the extremities of the wainscot receive the rails by tenons and morteses; while the intermediate muntins are tenoned into the rails. At C is seen an end muntin; at D is an intermediate muntin. In this case the moulding E of the rail is struck through without taking account of the joints. Then when it is necessary to connect the intermediate muntins, the moulding is cut away as indicated at F. Hence that moulding abuts against the heads of the muntins. Those are only chamfered or moulded on their free parts; the chamfers or mouldings stop at G by a cut, and leave to the muntin all its strength at the connections and to avoid always defective mitred joints. The panels H are inserted in grooves according to section I; if they are thinned at their edges to enter the grooves, they retain all their thickness at the centre as marked in section B′ at K. These panels are loose in their grooves and can shrink without inconveniences. The muntin and rails being assembled at right angles, the shrinkage due to the drying of the wood appears only in the joints, as always occurs in mitred joints. The entire system shrinks together. We give at L different modes of assembling the muntins and rails of the wainscot. At M the muntins have mouldings extending th through without taking account of the junctions of the rails and have the stops m at each connection. At N the muntins and rails both have stops at the connections of the muntins with the bottom rails or plinths. At M″N″O″ are the horizontal sections of the panels with the muntins.

When the wainscot is high it is necessary to divide its height by one or several intermediate rails that prevent too

long panels, always likely to warp. Thus (7) let a wainscot be 5.3 ft. high, one will first have a base or plinth A, into which will be tongued the bottom rail B. On this bottom rail will be assembled the intermediate muntins C, and itself will be tenoned into the end stiles D. The same system reversed w will be adapted for the top rail F and the cap E. But at G will be tenoned between the muntins cross rails H, so as to r reduce the length of the panels as we have stated. When this refers to wainscot attached to walls, these will often be simply set in rebates, as indicated in section I and retained by some iron clips. These panels nowise affect the framework, a and if they are made of dry wood, having only the width of a riven board or one sawn as we stated at the beginning of this Article, the entire work will suffer changes of temperature w without inconveniences. For the principal question in works of joinery is always to leave the wood the ability to swell o or shrink without affecting the connections. The tenons K of the muntins pass through the top rail and the cap so as to p prevent the warping of the latter, that does not fail to occur when these caps or mouldings are simply tongued into the top rail. Indeed, the thickness of these caps or mouldings being greater than that of the top rail, when they warp they have more power to split off the tongue made with the grain. This system of paneled wainscot was adopted during the 13 th and 14 th centuries with varying profiles. As for the connections they are always full up to the 15 th century, i.e., made in the members retaining their square forms.

The example that we give in Fig. 7 shows the mouldings of all the rails struck without stops and those of the muntins with stops at the connections. Even when the moulding enclosing the panel extends on the muntins and rails without stops, as we see practised frequently in wainscot of the 15 th century, mitred joints are avoided. We find an example of one of the pretty wainscots that line the chapels of the nave of the church of Semur-en-Auxois (8). The muntins and rails of this wainscot are 1.6 ins. thick; it is seen that the profile of the frame A is rounded in a quarter circle to continue along the muntins, but the connections are always solid and without mitres. This enclosing moulding does not return on the intermediate rail B, and that has slight chamfers with stops at

each joint. As for the lower panels, they have no enclosing mouldings but chamfers as if to give more solidity to this base. A cap C, whose profile is given at C′, is nailed on the face of the top rail. In the upper frieze D, perforated panels are set lengthwise to lighten the woodwork. The solid panels are only 7.9 ins. wide (9 ins. including tongues), 3/8 in. thick at the edges, but are reinforced by those projections r representing folded parchments. (See the horizontal section E made at the level e, and the section F made at the level f). At G is traced the vertical section of the wainscot, at H is the profile of the rail A, and at I is the stop of the enclosing moulding at the cross rail.

We give (9) several examples of these reinforcements of panels representing folded parchments. Example A shows the little decorated rolls passing behind those parchments.

In joinery preceding the 15 th century it was often customary, especially for furniture, to cover the panels with ass' skin or linen glued on the wood by means of cheese or skin glue. When this woodwork became old these facings must in part leave the warped wood; hence the folds of the recurved edges. It is to be presumed that the joiners had the idea of deriving from these accidents an ornamental motive and a means of giving thickness to the panels, while leaving their edges and t tongues very thin. Hence those panels with folded parchments so much in vogue during the 15 th and the beginning of the 16 th centuries.

Our workmen of the middle ages were not only skilled artizans, but they were observers, attentive to profit by all that chance caused them to discover. A defect, the effect of time on the materials, became for them a motive of improvement or of ornament. loving their trade because it was the result of thoughtful labor, and not a vague and unexplained tradition of a foreign art, they followed their own genius, invented n new combinations in the daily observation in the workshop, wi without borrowing outside the forms, whose meaning no longer had any meaning for them. Architects for a long time have already diverted joinery from its true line by desiring to impose on it forms not in harmony with its resources. During the two last centurier have been imitated many things by the aid of joinery, stucco, marble, stone, bronze, columns, hangings,

projecting cornices, arches , all excepting joinery, and this in the name of grand classical art. On the contrary it would seem that classical art consists in using wood, stone or metal according to the properties peculiar to each of those materials. If we open a treatise on joinery of these last times, we shall then see what? How Corinthian columns are made, arches and intersections of curves, corbels, trumpets with timbers and planks, so as to imitate in wood masonry works; how are made doors with wide frages, consoles and cornices projecting 1.6 ft., how all that can only be fixed by angles, bars, screws and glue. So that joiners have ended by no longer knowing to execute actual joinery, and that only for a small number of years some of them have commenced to leary again that art, practised four hundred years since with so much knowledge and taste. But it is always in the provinces of the north that must be sought works in joinery worthy of this name. Let us now occupy ourselves with doors, solid or open leaves and windows.

HUIS. Doors. Leaves.

The oldest doors that we still find scattered in some French provinces do not precede the 11 th century, and it must be r stated that at that epoch these joinery works are very rude. They consist of a series of simply joined planks, doubled by other planks so arranged as to be fastened to the former by nails. According to this principle are arranged the leaves of the doors of the cathedral of Puy-en-Velay and a leaf of the door of the church of Voulte-Chilhac (10). On the inner side A of this door appear only a series of joined planks; on the exterior B other planks are placed across the former and are nailed, presenting an appearance of panels covered by flat ornaments.[1] At C is given the section of the door made on a b. This sort of joinery is entirely oriental, like the ornaments that decorate it. One sees neither connections not any combinations both light and solid, that compose works of joinery. These are planks nailed on each other and nothing more. Very much later than that epoch, one still sees in the provinces of the centre of France doors, that start from the same principle, though less rudely executed. There exists in the church of Ga Gannat a door with two leaves (11),[2] where each leaf is composed of four joined boards. To make them solid and to prevent warping, the workman has placed outside a wooden framework f

forming nearly square panels. At A is presented the inside of the door. The detail B gives half of the extent of a leaf with its framework. Detail C indicates the mode of assemblage of the stiles and rails of the framework, the section D being m made on a b of the section F on e f. G presents the perspective connection of the rail, and F is the section at the lap. A nail with square diamond point head is set at the middle of each connection and in the rails and stiles between the connections. These nails at the joints of the boards have double ponits, clinched at right and left as seen at D. This work is solid, since it has remained in place since the 14 th century! but that is not a work of joinery as one sees it at that epoch and even earlier in the provinces of the North. The leaves of that door are hung by hinges nailed on the inside, as indicated in Fig. A. The boards and the framework are of oak, and f further the whole is well executed.

Note 1.p.361. See the interesting details of this door in Architecture et les arts qui en dependent, by J. Gailhabaud.II.

Note 2.p.361. This drawing was communicated to us by J. Millet, architect.

Fig. 12 shows us the old leaves of the door of the upper S. Chapelle of Paris. This work of joinery dates from the middle of the 13 th century, like the edifice; it was formerly decorated by paintings outside and inside. At A we present a leaf on the inside; at B on the outside. The system consists of a frame strongly connected with two stiles, three rails and diagonals intended to transfer the entire weight of the door to the hinges. The rails are fixed to the stiles by dovetails, and the diagonals are boxed besides the tenons, thus strengthening the work. On this frame are nailed boards tongued and grooved; then the decoration in this wood is nailed on these external boards. At C we have indicated the section of these bases. The hinges are placed inside on these rails.-- We have drawn only a single one of these hinge straps on the middle rail, they are doubled outside by thin iron straps ornamented by engraving. Thus these rails find themselves held between t two iron bands, and the nails of the hinge straps are riveted externally on these bands. Nails with square and very flat d diamond heads also connect the boards and the framework. The gable with its equilateral arch, cusps, crockets and little

columns, is only a facing held by bands. A strike existed at the junction of the two leaves with a centralstone mullion, and it forms a sort of little buttress on the edge of the leaf. On the inside the stiles, rails and diagonals are chamfered between the connections and make the members lighter. These leaves were very much changed by wickets cut through the doors and were almost entirely decayed in their lowe parts, and must be replaced during the restorations.

The use of this system of doors is very common during the 13 th and 14 th centuries. It is light and solid, and lends itself well to placing the fixtures for hanging. The doors of the cathedral of Paris, decorated externally by the beautiful ironwork so well known, are combined in the same manner and probably date from the beginning of the 13 th century, for we do not think that they have been rebuilt. Their outer surface beneath the ironwork was originally covered by very bright p painting of a laky tone.

The cathedral of Poitiers still possesses the leaves of its doors that date from the beginning of the 14 th century. These works of joinery have a certain interest, because they serve as a transition from the leaves composed of a frame on which was applied a covering of oak planks on the leaves with panels grooved into the frame itself. Further some of these leaves are already furnished with wickets. Fig. 12 bis presents one of those leaves at A for the inside and at B for the outside. The stiles a and b are thicker than the top and bottom rails; they are 5.1 ins. while the latter are only 3.9 ins. As for the intermediate rails, they are only 3.2 ins. Stiles of the same thickness are assembled between these rails and receive panels between them, as shown at C, D and the detail P. On t the exterior the entire framework and the panels are in the same plane, and these panels are distinguished from the other parts only by a sunk bevel indicated at G in detail P. Diagonals framed into the stiles C and having but half their thickness prevent the leaf from being deformed and from straining the connections by its weight. At I is traced a perspective detail of the connection of the diagonals with the intermediate stiles; These pieces are connected at their intersections by nails K with square heads and double points clinched inside. At L is traced the detail of the strike, furnished with a

little octagonal column projecting outside, O being the capital shown at o, R the ring r, S the base s. These details are at the scale of 1 : 10.

It was only at the end of the 14 th century that joiners undertook to make panel doors, i.e., with similar external and internal faces, composed of stiles and rails between which were grooved boards with rebates or tongues. The church of Notre Dame of Beaune still possesses at the beginning of the side aisles of the choir on the North side a door of that kind, which dates from the end of the 14 th century (13).

At A is given one of the faces of this door composed of two side stiles, two top and bottom rails, and three other intermediate rails and two muntins tenoned into the rails. At B is drawn the detail of a rail C with the intermediate muntin D connected to the end of the panel E. At F is the horizontal section of a panel wit the two muntins; at G is the vertical section of a rail with two panels and their tongues, at H we give the perspective detail of a muntin removed, its upper e end being at a. Already the panels are reinforced at their middle as indicated by the section F, and the little rounds of the muntins and rails that receive between them the tongues of the panels left free elsewhere. At the lower part of these panels chamfers cut through on the rails replace these rounds, so as to not catch dust. These rounds are mitred at the upper part of the panels and stop on the lower chamfers as indicated by our perspective detail H. Thus the rounds and chamfers can be struck along the muntins and rails without stops, and the joints being made later, by cutting away the rounds and chamfers where necessary to make stops and mortises. It is well understood that this door is of oak, like the preceding examples.

But the 14 th century made remarkable works in joinery. there remain to us from that epoch very beautiful stalls (Art. Stalle), fragments of woodwork wrought and assembled by the hand of a master. Neglect, love of change and false taste have allowed or caused to disappear a prodigious number of these art works. It is necessary today to seek the remains in some museums, to collect some traces of them preserved by old engravings or drawings. Normandy, Picardy, Champagne and Burgundy, were particularly rich in beautiful works of joinery. The lea-

leaves of the doors, very simple until that epoch, became afterwards a motive of decoration in wood. Applications of bronze were renounced, also historical ironwork, coverings of painted leather, to give the wood the richest forms, yet without abandoning the principles of true construction, that pertain to joinery. Then sometimes openings were left in the leaves of doors, and if they were of too large dimensions to be opened at any moment, wickets were made in them, as could be noted already in the example given in Fig. 12 bis.

Here (14) is one of these doors.[1] Its framework is composed of two wide stiles, two top and bottom rails, the wide intermediate rail, two diagonals B forming a gable, and two intermediate muntins C, halved to the diagonals in the upper part and serving as stiles for the wicket in the lower part. The panels A of the upper portion were open and probably glazed. To make the construction of this great leaf understood, we give at D the section made on a b, showing the caps of the intermediate muntins, at E is the section made on c d of the gable; at F the section made on g h, at G the section made on the intermediate rail e with the strike i of the wicket, at K the section made on the lower rail with the strike i of the wicket; at O P the vertical section made on the lateral panels of the lower part, at R the section made on n p; at S the scale of the entirety, and at s is that of the details.

Note 1.p.368. From a drawing from the collection of the late Gernercy. This door opened on one of the great halls of the abbey S. Ouen at Rouen, and it seems to have still existed at the end of the last (18 th) century.

There still exist a good number of leaves of the 15 th century; we shall cite those of the south portal of the cathedral of Bourges, those of the principal portal of the church Notre Dame of Beaune, those of the principal door of the mansion of Jacques Coeur at Bourges, those of the outer portal of the l library of the cathedral of Rouen, those of the hospital of Beaune, as among the most remarkable. There were frequently employed in the 15 th century these leaves with openings, either for closing vestibules, chapels, oratories or even closets, i.e., cabinets opening from a chamber. These leaves with openings were even sometimes divided and could be folded like our shutters, so as to not occupy space in the little rooms

when left open. One still sees at the entrance of the north chapels of the church of Semur-en-Auxois one of those doors executed with perfect taste (15). This door is composed of two leaves, each folding in two parts. At A we present the e exterior of a leaf and at B the interior. The horizontal section C is made at the level D of the section E at the level F. The division is indicated at G and the strike of the two leaves at H. At I is traced the vertical section of the upper rail and of the entermediate rail. At K is the section a b at full size. This pretty joinery still retains its ironwork, w which is very finely executed (Art. Serrurerrie). All this o opens easily and is agreeable to the hand; it is indeed joinery of an apartment, light and elegant, solid and made for d daily use. However,nothing is more simple than its construction, as shown by our Fig. Here the mouldings enclosing the panels are returned without stops, but are not mitred, the square returns of these mouldings being cut across the grain of the muntins. The projecting strikes of the middle of the divisions are pinned on the muntins like the mouldings L. There are neither nails nor screws; the iron fixtures alone are held by means of clips very skilfully arranged to weaken neither these fixtures nor the wood.

Inside the sashes of windows were placed in the apartments solid or open shutters, that were actual leaves. The openings of these shutters were sometimes made in their lower portion to allow one to look outside without opening the shutters.

Fig. 16 represents one of these shutters [1] made solid and made of great thickness; the principal frame A (See section B made on a b) encloses a second sash C, that supports the panels D. At E we have drawn the section made on e; at F is the section of the two intermediate rails with the stile. The lower panels are delicately opened to the profile G, the secondary members of that opening only having the thickness h i.

Note 1.p.370. From a house at Abbeville, Rue du Moulin-du-Roi.

The art of joinery in the 15 th century reached a perfection in execution never attained since. The taste then dominant in architecture further lent itself to forms that suited joinery, since the works in stone had the defect of recalling the delicate combinations given by the use of wood. The joiners of the 15 th century employed only woods perfectly purified,

dry and sound, and they worked with skill, that we have great difficulty to attain today, even when we desire to pay for t the workmanship. The joinery of the second half of the 15 th century is no very rare in France, and due to the excellent selection and dryness of the woods employed, this joinery is well preserved, is neither deformed nor cracked, and is only injured where placed in conditions entirely unfavorable.

To close our study of doors, and leaves of doors, we shall give here one of these, that closes the principal entrance of the nave of Notre Dame of Beaune. The construction of these leaves (17) is simple and it consists of 20 panels tongued in between the stiles and rails; a wicket is composed of four p panels a and opens at the middle of the leaf. Two stiles, two top and bottom rails, three intermediate muntins with four i intermediate rails form the frame of that leaf. The stiles are reinforced by buttresses and intermideate rails by projecting mouldings. These buttresses and the panels are delicately moulded and carved in beautiful oak wood.

We give (18) some details of this work of joinery, i.e., the panel b and part of the lower one c wit the buttresses and stiles and profiles of the in ermediate rails. At A is traced the section of these details made on e f; at B is the horizontal section of a stile with its buttress, at C the section at a larger scale of the mouldings cut in the thickness of the p panels. This mode of ornamenting the panels by compartments cu to half thickness and representing the tracery of windows was much in vogue in the 15 th century, and it was necessary for these panels to be very easily and rapidly carved, for t they are found everywhere. The working joiners fashioned these works by means of long chisels, gouges and gravers, with handles indicated by the sketch G. The great gouge g often terminated in a sort of spoon like the tools used by makers of w wooden shoes, was used in both hands, the piece of wood wrought being kept horizontal on the bench by means of a clamp or screw as practised today.[1]

Note 1.p.373. We have frequently seen miniatures of manuscripts of the 15 th century in which these tools are represented. There exists in the stalls of the church of Montreale a relief representing a joiner carving a little pinnacle by means of the tool represented at l, which he holds in his right

hand. At the scale this tool appears to be at least 20 ins. l long. As for the chisel, it was in frequent use, as in our days.

All the panels of these leaves of the doors of the church of Beaune are of varied design; sometimes instead of these compartments of tracery were carved reliefs or arabesques about the end of the 15 th and the beginning of the 16 th centuries. Among the beautiful examples of leaves, we should not omit t those of the doors of church S. maclou of Rouen, attributed t to Jean Goujon, and if not by him, at least they present one of the best examples of the joinery of the Renaissance.

CROISEES. Windows. Sashes.

We explained in Article Fenetre how during the Romanesque period the openings of windows were not often closed, except by shutters at night, and how to obtain light in the interiors of rooms, air was allowed to enter wit the light into the apartments. These shutters at first were pierced by small openings over which was stretched parchment or canvas, or even c covered by a piece of glass. That custom was long retained a among the peoples of the Centre and South of France; but in the North the rigor of the climate and the insufficiency of external light compelled the inhabitants of cities and castles to make actual sashes suited to receive a large surface of glass or parchment. In the 12 th century these sashes or windows (to apply to them the name sanctioned by custom), were still only actual shutters composed of stiles and rails, but whose wooden panels were replaced by glass or by oiled vellum.

Of these works of joinery exist very few remains. Yet at P Paris in the tower called Bichat's, the old commandery of the Templars, and that was destroyed nine years since, there still existed in a window of the highest story, composed of two parts separated by a mullion, two window leaves that appeared to belong to the epoch of the construction of that tower (about 1160). Set in an enclosure of plaster already old, they were able to escape destruction, and although entirely rotten, they still retained fragments of white glass set in rebates. Fig. 19 gives the inner surface of one of those window leaves with its ironwork. At A we give the section on a b, and at B the horizontal section on c d. This sort of glazed sashes allowed little light to enter, relatively tc their areas; but then men did not require much light in interiors, as they do

today. These sashes were without frames and shut into rebates in the stone openings.

In the 13 th century men were already no longer satisfied w with such small openings, windows became high and wide, their mullions were diminished in thickness, and consequen ly the w window sashes were made lighter to allow the light better to enter the halls. The sashes in the joinery of tha time no l longer exist except in fragments, and it is necessary to collect much scattered data to be able to restore an entire sash. The fixing of the fixtures and the rebates preserved in the j jambs, the traces of the strikes however still exist in a great number of buildings. At the gate of Laon, at Coucy (beginning of the 13 th century), at Carcassonne (end of 13 th century), at Loches, at Chateau-chinon, at the palace of Justice of Paris, and in several castles and houses in our old provinces, it is easy to determine the position of the glazed sashes, their fastenings and thickness. Then by seeking with some care, one also finds here these remains of this joinery, repaired many times, it is true. Thus in the abbey building of Chateau-Landon, we have found a window almost entire by seeking certain primitive fragments some years since, among repaired sashes.

We give (20) the result of these researches. These sashes were double in the great windows and were separated by a mullion; they were composed of a muntin A B with iron pins at the top and bottom, fixed to the muntin itself. These two pins e entered eyes set in the stone, as one can still see in the e interiors of the windows of the house of the Musicians at Rheims, and many other habitations of the 13 th century. Thus the sash was set in building; the strike C shut into a rebate on the mullion of the window and was held by two bolts moved by a round iron rod wi h handle (Art. Serrurerie). Two top and bottom rails were tenoned into the two muntins. A third intermediate muntin was fixed in the top and bottom rails, and in its turn received two other strong intermediate rails D and two lighter cross-bars E. Little columns F took the place of sash bars. On the outside the muntins and rails were provided with rebates G (see detail H) intended to receive the glass panels. As for the sash bars they had no rebates but iron buttons I, that served to hold the panels. These window sashes

were fitted inside with divided shutters (see horizontal section K) and separated in three parts a b c, so as to be able to open as seemed good only one division, or one third or two thirds of a division. because of the jamb of the window, these shutters divided at g moving only to the right angle and were arranged a indicated by the dotted lines l. Unfolded, these shutters presented at the side of the window the Fig. L, and their divided hinges were placed on the inside g. The upper a and lower panels of the shutters were perforated to give light in the interior when the shutters were closed, and to allow one to look outside through the lower openings. The muntins of the sash are 2 ins. thick, those of the shutters being 1 1/2 ins. at H are given the details of the little column and their profile as at H'; at M is the section of the intermediate muntin. at N the section of the cross-bars E; at O the vertical section of the rails of the shutters, and at O' the horizontal section of their strikes. P is the detail of the lower openings. The shutters were fixed on the muntin of the sash by hinges riveted outside on little iron plates. This sash did not have a water drip; the rainwater that flowed down their external surface was collected in a little gutter cut in the sill and leading outside. Finally, the shutters were kept closed by means of bolts entering staples fixed on the internal projection of the stone mullion, and at need by bars.

To set these sashes, there was no holes or fastenings to m make afterwards in panels, rebates or splays; the article came to its place complete and finished in the workshop, without its being necessary as now practised in our structures, to send successively workmen of two or three trades to finish t the setting of the ironwork of a window. The masonry, carpentry, joinery and ironwork, were finished simultaneously, and when the roofs were covered, there was nothing more than to paint and to hang the tapestries. When the window sashes did not swing on pins like these, when they were set afterwards, the hinges that held them were fixed in the beds of the courses during the construction, so as to avoid cuts and holes for fixing, that injure the fronts of our houses and palaces.

Window sashes of houses of the 14 th century were often simpler than these and were only composed of muntins, strikes and rails. The sash bars were useless when were employed glass o

panels set in lead, and they commenced to appear in the sashes, when were substituted for panels set in leads, glass cut in quite large pieces from the circular sheets of glass with a knot at the centre. (Art. Vitrail). The window sashes of the middle ages then do not present the network of sash bars shown by the sashes of the 17 th century, and that produces such a displeasing effect by the monotony of those equal components cutting the area of the opening into a quantity of little parallellograms. The glass panels were fixed in the rebates of the sashes by means of a cement covered by a strip of parchment attached to tha cement, or simply for interiors where it was not important to obtain perfect tightness, by buttons of the sort reproduced above at I. Then between the panels, the buttons being opened, a strip of felt was introduced at the junction of these panels, the strip being cut at each button; then these we e closed and exerted a pressure on this felt, and prevented the glass from shaking. That custom was long retained in the provinces of the Centre, since we have still seen these felts and buttons fixed on sashes of the 16 th o century.

Window sashes of the 15 th century in mansions and castles sometimes formed a tolerably complicated work of carpentry. Mansion de la Tremoille at Paris still possesses in the story over the portico looking on the court, window sashes, very dilapidated and belonging to the original construction, dating from the end of the 15 th century. These sashes (21) are in windows composed of the cantral mullion and transom bar of stone. They consist then of four compartments; two large oblong below and two square ones. At A we give one of the lower sashes aud at B one of the sashes set above the bar.

These sashes had frames fixed in the stone rebates by clips as still practised today. The lower sashes could be opened in their entire height from a to be by means of handles, and partially by an inside sash from c to d. The upper sashes also opened by handles. At C is traced the section on e f, the sashes A B being viewed from the inside. At D is indicated the lower angle of the sash A with the water drips on the outside.

We have drawn at a double scale, i.e., at 1 : 10, at A' the section on g h; at F the section on i k; at G the section on l m; at H the section on m n, and at I the section on o p. At

L is given the section on r s and at M the section on t v. Op Open leaves of shutters in V X Y folding in pairs are indicated at m, hung on the frame, and allow the glass to be covered inside.

These sashes in good oak wood were drawn and made with great care; these glass like ours were set in rebates and cemented. Fig. 22 gives the junction of the lower water drip A and the vertical frame B. One sees at B how the water drip of the great opening sash is partly housed into the frame having a drip. This gives the profile A of that drip; this profile was drawn so as to present rain driven by the wind from following the slope a b and ascending into the joint c. The curve d b compels the drop of water, driven by the wind over this moulding, to follow the curve d e, i.e., to fall outside again. These details show with what attention the joiners of that epoch m made their drawings, and how they gave to mouldings a form m suitable for their places and purposes. It must be recognized that since that time we have not made sensible progress in the art of joinery and building.

Window sashes were not ironed then by means of inlaid iron angles as they now are; the irons of the handles that sometimes form angles were fixed on the wood by means of nails and rivets (but not sunk); it was then necessary that the connections of these sashes should be very well made to avoid deformation and dislocation. Sunken angles are a good thing, but the joiners mistrusted them too much to maintain the connections; then they singularly contributed on the exterior to hasten the decay of the wood at these connections.

VOUSSURES, PLAFONDS, TAMBOURS.

Curved Surfaces, Ceilings, Partitions.

As we have already stated, the joiners of the middle ages knew how to treat wood and to keep their drawings within ordinary dimensions, that were then nearly the same as these produced today by the mills. Particularly in large joinery the attention is found to be devoted to this important part of t their art. The plank 1.5 to 1.6 ins. thick was generally employed for the framework, then that 3.2 ins. thick for the heaviest parts. As for the panels, they were rarely over 3/4 in. With these dimensions of the wood they composed their most i important joinery, such as drums, organ fronts, stalls, clock

cases, stairs, large grilles, etc. To give strength to these woods when they had great dimensions in height and prevent them from buckling, they tongued the timbers as indicated at A, for example, and assembled them in the timbers at base and cap as seen at B and C. Further the muntins were connected and maintained by gussets D forming arches. The spaces were filled by free panels E, or assembled by tongues (Art. Stalle).

Villars of Honnecourt [1] has preserved for us a curious drawing of a great clock case of the 13 th century in joinery. It is an actual campanile that must have great importance. There are still seen such clock cases in great joinery of the 14 th and 15 th centuries in the cathedrals of Beauvais and of Rheims.[2]

Note 1.p.382. See Album of Villars of Honnecourt, Pl.XI.

Note 2.p.382. See Gailhabaud, Architecture du Ve au XVII siecle

Although there remain only a small number of fragments of the wooden wainscot, that frequently covered the walls of castles during the 13 th and 14 th centuries, yet one can prove its use by numerous fastenings and traces that still exist on the surfaces of those walls; fastenings and traces indicating works of great joinery covering entire rooms from floor to ceiling, and composed of members 1.6 ins. thick by 3.M ins. wide with panels. Ceilings of joinery were made thus from the 14 th century and perhaps before that epoch, or to be more correct, ceilings in the composition of which carpentry and joinery took their parts. Thus it is not rare to still find ceilings where the spaces between the beams, instead of being plastered, consisted of boards placed crosswise, perforated and covered by a board placed lengthwise (24).[1] But in Article Plafond we shall have occasion to describe the different mixed combinations adopted by the carpenters and joiners of the middle ages.

Note 1.p.384. From a house of Cordes.

In the 15 th century and even also in the 16 th, joinery o ceilings instead of participating in the carpentry, as in the preceding example, were fastened to that by pendant keys. Fig. 25 shows one of those ceilings, alternately composed of corbels and coffers. The sketch A indicates in horizontal projection the system of framework, consisting of a series of equilateral triangles. The kingposts B into which are assembled the pieces D releived by struts and suspended from the doubled

joists indicated at E in the section C by means of keys F and mortises. The section G is made on a b and that at H on e f, and they explain the arrangement of the corbels and coffers. The strata forming the corbels were covered by thin boards between them, and ornaments were carved on the edges of the ribs. The coffers were raised more or less and decorated. This system was adopted again, but with some variations, in certain ceilings preserved to us by engravings, or that still exist, such as those of the palaces of justice of Rouen and of Paris. The old Chambre des Comptes, burned during the last (18 th) century, possessed a very beautiful example of this kind, that has served us in making the drawing of Fig. 25; [1] it had been established under the reign of Louis XII, and besides the sculptures was entirely decorated by painting and gilding.

Note 1.p.385. Topog. de la France. Imp. Library.

The trade of joinery required an extensive knowledge of descriptive geometry in the last times of the middle ages. It is easy to convince one's self then, if he will examine the stalls of the cathedral of Amiens and most of the works of joinery in the 1, th and 16 th centuries. The execution demanded infinite care and time, for one cannot execute good joinery except by using in it the time and money necessary, particularly the time. When it required 15 days for a good journeyman joiner and 15 more days for a wood carver to make a corner po post of a pulpit, of a grille or a partition, one was certain that this post, turned so often on the bench, selected and reduced, was very dry and that all changes had occurred before setting; so those delicate joinery works of the 14 th and 15 th centuries have not moved and have remained just as they w were assembled. Besides those artizans chose their wood with extreme care, and left it for a long time in the storehouse before bringing it to the workyard.

MARQUETERIE. Marquetry. Inlaid Work.

Marquetry was not employed during the middle ages in France to decorate the joinery works of buildings; it was scarcely applied to furniture; also this marquetry was very rare before the 16 th century. The custom of veneering with woods of different tints in order to compose colored designs, that could not be applied to the forms of Gothic joinery, which alw-

always depended on the carpentry. Architects caused their delicate works in joinery to be painted and gilded, but their c construction was such, that it is not possible to veneer them, as the preceding examples show. On the contrary in Italy, marquetry took its place in the joinery from the 14 th century; but also as we have stated, the forms given to that joinery are always in accord wit the construction. In the matter of the works of French marquetry, we only know of the backs of the stalls of the chapel of the chateau of gaillon, and those are works of the beginning of the 16 th century. One can still see certain parts of the winter choir of the canons of the imperial church of S. Denis.

MEUTRIERE. Slot for Archers.

We have seen elsewhere [1] how permanent Roman fortifications were only defended from their tops. The curtains and towers were solid at the base and opposed to attacks only the thickness of their construction; but when movable casting machines were perfected, and had acquired a longer and surer range, m men no longer restricted themselves to crowning the parapets with battlements for preventing the approach to a strong place; openings were pierced at the base of the curtains and in the different stories of the towers. Those openings appeared in fortifications from the beginning of the 12 th century; then quite rare, they multiplied during the 12 th century, and participated in the means of defense; about the middle of the 14 th century, those openings again became gradually rarer in t the lower parts of the defenses and multiplied at their summits; they only reappeared at the moment when artillery replaced the ancient machines for defense. These slots for archers, pierced at the level of the ground inside the ramparts and of the floors of the towers, not only permitted shooting crossbow bolts and arrows, but also to see without discovery the works that the assailants could attempt to batter or sap the works. Among the oldest slots mentioned, we shall cite those of the towers and curtains of the castle of the city of Carcassonne, a castle whose construction dates at the beginning of the 12 th century. These slots (1) consist inside of a sort of niche covered by a segmental vault intended to receive at least one defender. The wall is reduced to a thickness of 2.3

ft. by the construction of the niche, and is pierced by an o opening splayed inside and very narrow on the exterior, so as to cover the exterior by an angle of 35°. A lintel with a semicircle cut in it covers that opening, and a very steep slope terminates its lower part. The sketch A gives the plan of this slot, B is its section on a b, D is its inside elevation, and F is its external appearance. To give more range to the angle of fire, the lower part of the slot, which is only 2.4 ins. wide, is cut as indicated in the detail C; d being the plan, e the outer face of the section.

Note 1.p.386. Arts. Architecture militaire, Cremeau.

The method that served for drawing this bottom opening of the slot is this (2); A B being the internal opening of the slot; C D the opening desired to be given at the bottom, taking the points a b at a distance of 1.2 ins.; from those points a b are drawn the two lines a D, b C. Those notches were originally triangular' about the middle of the 13 th century they become square, as we shall show them at once. These slots are pierced alternately in the towers, i.e., they are not placed over each other, but solids over voids, so as to cover all points of the circumference. It was only in the 13 th century that men recognized in piercing the slots the use of a constant method, a very skilfully calculated mode of tracing. At that epoch slots exactly flanked the curtains at their bases and summits, so as to enfilade the entire surface from one tower to the next. Here is the drawing of a tower with three stories and the battlement story, like the most of those that flank the internal enclosure of the city of Carcassonne on th the southern side.

Above the footings or slope this tower with diameter of 19.7 ft. and walls of 3.9 to 7.2 ft. around the circumference A B is traced the circular arc C D; dividing this arc into 16 equal parts, o e, e f, f g, g h, etc., taking on the outside of the tower the points p at 1.0 ft. from the face of the curtain, the external surface of this tower is divided into 8 equal parts. Then from the points e, g, i, k etc., are drawn lines passing through the division points of the circumference of the tower. These lines gave the openings of the slots pierced in the three stories; the slots a belonging to the ground story, b to the second and c to the third; the slots flanking

the curtains being thus doubled in height. Then all points of the circular arc C D are seen, and beyond the arrows cross e each other. Let us add the upper defensive galleries to these slots to command the foot of the tower (Art. Hoard), and this work is entirely defended, the curtains are enfiladed by these slots on each flank, two over each other in the ground and t third stories, and the third a little in front.

The slots of works of small dimensions have no internal niches; they are only proper in a wide splay. We reproduce (4) one of these. A gives their plan, B their section on the axis and C their internal elevation. The lower end of the slot is widened to extend the range of fire by means of a square notch, whose detail is sketched at D (external elevation) and at E (section). At F we have given an internal perspective view of this sort of slot, adopted from 1250 to about 1350.

In the important works of the city of Carcassonne, the slots t that pierce the towers and curtains built under Philip the B Bold possess niches quite similar to those of the castles of the 12 th century. But then the walls are thicker; these niches are surmounted by round arches, and their walls are furnished with stone benches. Here (5) is one of the slots of the tower called de Tresau. At A we give the plan; at B the section on the axis; at C the internal elevation, and at D an internal perspective view. These dimensions seem to have been regulated, for they are similar in all works of the same epoch. The inclination of fire and consequently the length of the s slot are modified according to the position of the slot with regard to the external ground, these inclinations being all directed to the same circumference at a given distance from the foot of the tower, as indicated in Fig. 3.

Some archaeologists have claimed that these slots, pierced in the different stories of the towers and at the base of t the curtains, were rather made to permit one under cover to see what passed outside, than for defense. It is certain that these long slots facilitated the oversight of the exterior, but it is impossible to admit that they did not serve for defense. The lower opening alone that widens the angle of fire demonstrates their function. We have attempted to shoot through these slots, not with a crossbow, which is as easy as with a musket, but with a bow; the sides of the slot, instead of in-

injuring the fire, fulfil the office of a mirror and on the c contrary make it more certain, than if one saw the object in the open air. Further, the texts of the 12 th and 13 th centuries frequently mention these slots for casting, shooting a and defending. One will note, that when the walls have a great thickness as in the preceding example, the constructors have always made those wide niches, which allow the archer to approach the external surface, which diminishes by so much the depth of the splay.

Yet there exist very strong defenses from the beginning of the 13 th century, whose quite rare slots were made rather f for watching the exterior than to offer a means of defense. A At the Laon gate of the city of Coucy, whose construction dates from about 1210, the two great towers are pierced by slots whose small angle of opening and extreme depth, could only give a view of one point, also light and air in the interior of the halls. Here (6) is one of those slots.

At A we have traced the plan; at B the section, at C the internal elevation. Here the constructor feared to weaken the walls by deep niches, and has given to the splays of the slot only a very small angle of opening. The slots are not widened at bottom and extend the range of fire, and although these sl slots are ver high above the ditch, their inclination is not great. This sort of slots can then be regarded only as outlooks on the exterior and inlets for light and air. The niches have no benches, which is again an indication of their use not for defense, for everywhere that a sentinel or a defender is placed inside towers and buildings, there is found the stone bench. The projection D supports the floor.

We have stated that about the end of the 14 th century, men renounced slots pierced in the lower stories of towers and c curtains. Indeed at that epoch the art of the miner was quite perfected, and that these long slots indicated externally the weak points of the structure. By digging a mine between two of these slots, one would be almost certain to cause a part of the wall to fall. The advantage derived then from piercing the lower slots did not compensate for the dangers that they presented for the besieged. Then were established permanent defensive galleries or machicolations at the tops of towers and curtains, with battlements and slots pierced at the middle

of the merlons. The lower construction remained entirely solid with slopes, thick and homogeneous, and consequently much more suitable to resist sap or mining.

Then the slots are only found at the tops of the defenses or at certain points where sentinels were placed, for example over the gates and beside them, in passager, at both sides of the portoullis, etc. From the middle of the 14 th century the slots on the exterior only consist of a simple opening or with a bottom notch, the slot is often enlarged at its middle by a hole forming a sort of cross, as indicated in Fig. 7. 1

Note 1.p.393. From the remports of Avignon.

Naturally, the shooting arms imposed the form of these slots. From the 15 th to the middle of the 14 th century in France, only the crossbow was employed as a hand arm for shooting. N Now the crossbow is an excellent arm for direct shooting; it has the qualities of the musket, except its range. Archers were little employed by the feudal armies of the royal domain. On the contrary in the North, in Flanders and England, they formed considerable bodies and had acquired, as we have experienced too much at Crecy, a marked superiority over the cross-bow men, because of the rapidity of shooting with the bow and the extraordinary range of the arrows. But in battle these archers shot in the air rather than point blank, and for whoever has practised shooting with the bow, it is easy to appreciate the effects of shooting in the air. After describing a parabola, when the arrow falls vertically it is a terrible projectile, since one cannot protect himself from it. A moderately expert archer easily sends an arrow obliquely to a height of 131 to 164 ft.; reaching the end of its flight, it describes an abrupt parabola,and falling vertically from that height, it pierces a plank 1.2 ins. thick. Instead of arranging slots for shooting directly with crossbows and only from the top downward, they are so made that archers can shoot in the air, either by an intermediate opening a (Fig. 7), or by an upper opening b. Thus (8) the crossbow men or the archer could send the arrow directly, and the archer alone could shoot the arrow B through the middle opening, or through the upper opening the arrow c. Besiegers protected by mantlets avoided the projectiles B with difficulty, but could not protect themselves from the projectiles C. The necessity of leaving the lower parts

of towers and curtains entirely plain to better resist sap a and mining, and the frequent use of archers from the middle of the 14 th century for the defense as well as for the attack, caused slots to be pierced at the top of the defenses and led to widening them as indicated by Fig. 7. Indeed in Guienne, Maine, Poitou, and the North, that these cross slots appeare d at first, i.e., in provinces then occupied by the English armies, in part composed of archers. In the walls of Avignon, that date from the middle of the 14 th century, we likewise see cross slots; but the Popes of Avignon had only mercenary troops, and among them were archers recruited in Switzerland and and Dauphiny.

This sort of slots is found everywhere in France from the 15 th century; their form was definitely adopted as the best, because allowing shooting direct or in the air. Artillery then came to modify anew the form of the slots. They were only composed of round holes for passing the muzzle of the musket with a sight opening above (9). Sometimes these holes are double with a horizontal slot between them. Here is one of those slots taken from the eastern gate of Angelsheim.(10). One will note that these holes are pierced in a quite thin slab set f flush with the exterior of the wall of defense and surrounded by a recess in the masonry inside. A musket ball coming from outside might well break the slab. This slot is pierced beside the gate and commands the road descending toward the village; this explains its height above the ground inside. At A the slot is presented on the exterior; at B the interior, and at C in section. But the rapid progress made by artillery in the 15 th century greatly perplexed military constructors. Th They abandoned with difficulty the old system, and opposed to the effects of the new projectiles obstacles almost always insufficient. It was only at the end of the century, that the e engineers or architects arranged actual loopholes for musketry, and among these may be cited as particularly interesting, those of the bastion built before the Laon gate at Coucy. This bastion today in great part is covered by the imperial road, swept the plateau and enfiladed the ditches of the city by m a subterranean work pierced by means of loopholes and small embrasures. It must have been e erected about the last years of the 15 th century, if one refers it to the same sculptures and mouldings, that decorate

the vaults of the subterranean story.

This bastion, whose entirety is given at A (11), has at its base at about 3.3 ft. above the bottom of the ditch, the gallery covered by a round tunnel vault 3.9 ft. wide. A chamber vaulted by pointed arches is constructed behind the salient. The galleries are pierced at close distances by slots arranged so as to cross the musketry fire at the bottom of the ditch, as indicated by the dotted lines at B. At C we have drawn the plan of the chamber of the salient with its two slots a and its vents b pierced in the vault; at D is the plan of one of these slots on the front, which are doubled in the height of the surface. At d are also vents. The section E is made on e f; at G on g h, and at H on i k. These galleries are pierced by numerous slots, and are evidently intended to prevent the work of the sap and the mine at the foot of the bastion. All this construction is executed with great care and is perfectly preserved. In Article Porte we shall explain in more detail the utility of this work, so interesting by its date and so complete.

MISERICORDE. Miserere. Edge seat.

A little corbel arranged beneath the movable seat of a stall, serving as a seat, and permitting the religious to sit on it when the seat is raised, while appearing to stand.(Art. Stalle).

MITRE. Chimney Cap.

The cap of a chimney flue intended to prevent the rain or wind from entering the flue while allowing the smoke to escape. During the middle ages the caps were made of terra cotta, brick or stone. Perhaps some wrought iron ones existed, but we have found none in place, although sometimes fastenings remaining at tops of chamney flues indicated the presence of an iron cap.

There still exists in the hospital of Sens a beautiful cap of glazed terra cotta, that appears to date from the 13 th c century. Here (1) is a sketch of it. This cap is in form of a ridge tile and allows the smoke to escape by three vertical openings, four lateral holes and both ends. The arrangement of these exits was well made to prevent the wind from entering the flue. At A we give the horizontal projection of that

cap, at B its cross section, and at C its side. The projections bordering the little cylinders are obtained by a stroke of the thumb in the moulding while it was still fresh and after the fixing of the cylinders on the top of the ridge tile. However at that epoch chimney flues habitually ended in cylinders and the caps then took the conical form. One of those conical caps of glazed terra cotta was still seen some years since on a h house of the 14 th century attached to the eastern gate of t the city of Semur-en-Auxois (2). At A is traced its horizontal projection and at B its elevation. Sens, Troyes, Villeneuve-sur-Yonne, still possess some remains of those old chimney caps of terra cotta. But in provinces where the stone is resistant and easily wrought, the flues almost always have caps belonging to the construction, and the capitals of these flues are actual caps. Likewise in the provinces where brick was used during the middle ages, the caps are made by means of combining tiles and bricks (Art. Cheminee). The architects of the m middle ages always sought to decorate the parts of the construction relieved against the sky and to give them a pleasing outline. In vignettes of manuscripts of the 15 th century are seen chimney caps richly ornamented; but unfortunately the f fragility of these details of public and private edifices, v very exposed to storms, has caused their destruction in all our old cities.

During the period of the Renaissance very beautiful caps of glazed terra cotta and even of faience were still made. Those faience caps are composed of several round parts fitting on each other, and sometimes curiously ornamented by delicate d details in relief or painted, too small in scale indeed for the places they occupy. But then the true feeling of the external decoration of edifices was greatly changed, and those c caps of fine pottery, very pretty to see closely in a museum, produced no effect on the top of a roof.

MOELLON. Rubble.

Stones of small sizes and low in height supplied by the quarries for building walls with mortar or plaster. Rubble is pointed or rough. Pointed rubble presents a dressed surface, rusticated and that does not require to be plastered. Rough rubble has no regular form, i.e., it has neither beds nor face.

Pointed rubble was much used in the middle ages in the construction of houses and of edifices erected at small cost, and this sort of structures are excellent, because their surfaces are perfectly connected with the internal rough masonry. In s some provinces of France and notably in Burgundy and Gharelais are several large beds of limestone, hard and compact, that splits in very thin layers of 3.9 to 7.9 ins., and regular, which thus furnish excellent pointed rubble, only requiring a very slight preliminary dressing. Thus in those provinces are seen many old monuments whose surfaces are faced with pointed rubble presenting a surface as plane as that of cut stone. Between the buttresses the walls of the naves of the churches of Vezelay, Pontigny and Beaune are faced with pointed rubble admirably preserved. Transportation being then difficult, one understands why the constructors could more easily o obtain pointed rubble, which they brought on the back of an ass if necessary, than cut stone. They reserved the latter for columns, angles, piers, buttresses, plinths, cornices and window sills.

The Romans frequently employed pointed rubble, but in pieces presenting square surfaces externally ind not rectangular. T This tradition was followed in certain provinces of France u until the 12 th century. Thus the nave of the cathedral of Mans, for example, whose construction dates in the 11 th century, presents external surfaces that have all the appearance of a Roman structure. On the banks of the Mayenne and of the Loire are seen a number of edifices of the 11 th and 12 th c centuries, that offer the same peculiarity. Beauvoisois and a part of Valois still retein numerous remains of structures of the 11 th century, tha one could believe were built by Roman masons.

MONTOIR. Horseblock.

A step sufficiently high to allow mounting a horse without the aid of the stirrup. There was not a court of a castle, m mansion or inn without one or more horseblocks. They were for women and men, and the flights of steps that play such an important part in the habitations of the lords were accompanied by horseblocks. Horses and mules were prepared to go to the horseblock, i.e., were brought sufficiently near thos steps

that the rider could easily place himself in the saddle. A horse that would not go to the block was reputed vicious. One understands that for a man heavily armed the horseblock w was a necessity, and without the block the rider could scarcely bestride his horse at that epoch when armor had a very considerable weight.

There was at the Louvre of Charles V a block for the king and one for the queen. We have seen one of those horseblocks (1) in the court of mansion de la Tremoille at Paris, placed beside the rear facade beside the flight of steps. This block was cut in a single block of stone and consisted of three steps, the last forming a little landing.

The flight of steps at the castle of Pierrefonds was accompanied at right and left of the principal flight by two large horseblocks (Art. Perron). Before the inns was always outside a stone horseblock, and in the court were several wooden blocks, a sort of stool that was moved at need. The blocks were decorated by tapestry on days of ceremony in castles of Paris. At the ends of the lists during the tourneys were placed horseblocks for the combatants, and then to place one's self in t the saddle without the aid of the block was regarded as an act of vigor.

MORTAISE. Mortise.

A term of carpentry and joinery. The mostise is the cavity that receives the tenon. (Arts. Charpente, Menuiserie, Tenon).

MORTIER. Mortar.

Composed of sand and lime. To make good mortar river sand or gravel has been recognized as the best. Whatever the quality of the sand of the plain or pit, that sand is always mixed w with a certain quantity of clay, and does not fulfil the conditions necessary for making good mortar.

During the middle ages mortars are of very different qualities, sometimes hard and compact as in Roman structures, sometimes of mediocre quality in the 9 th, 10 th and 11 th centuries. It seems that men had then lost the procedures of making lime, and it is but exceptionally that one finds in the edifices of that epoch mortars offering a certain consistency. In the 12 th century, mortars commenced to resume strength; dur-

during the 13 th, 14 th and 15 th centuries, excellent mortars were made.

The quality of the mortar is then one of the means furnished to architects for recognizing the date of an edifice, but it is more characteristic than other signs. Mortar employed in Romanesque monuments preceding the 12 th century is sometimes mixed with bits of tiles, especially during the 10 th century and earlier; it is lean, i.e., contains little lime, and that is badly burned. In the 11 th century are found in Ile-de-France, Champagne and Burgundy, mortars composed of fine gravel (often plains sand) and lime in quantity, but badly burned a and drowned, having no strength. The bits of tiles have disappeared. In the 12 th century, particularly in the second half, mortars are uniform, well made with fine sand, sometimes chosen with care and sifted. After the end of the 12 th century mortars generally become very good and are of two kinds. The mortar of concrete is made of very coarse gravel, that of the joints and beds with good river sand, fine and pure. The lime used for the beds and joints is whiter than that of the concrete, which is much mixed with bits of charcoal. During the 14 th and 15 th centuries is frequently employed plains sand, v very rarely coarse gravel; the mortars are frequently mixed, the lime well burned and slaked. But then the plains sand employed seems to have been washed, for it contains no clay. Only in certain parts of Picardy the clayey sand was used without washing in making mortar, and although these mortars may have acquired hardness, they have always cracked in the concrete and do not present a perfectly compact mass.

Constructors have employed the lime such as could be furnished by the limestones at hand. These limes are hydraulic in provinces where the limestone possesses that quality, fat in provinces where the limestone contains very little clay. Consequently they were not acquainted with artificial hydraulic lime. But from the end of the 12 th century their fat limes had acquired very great hardness, even in foundations, as we have recognized in the substructures of the cathedrals of Rheims, Amiens, Paris, Sens, etc.

It must be stated that at that epoch, i.e., at the beginning of the 13 th century, reasons of economy sometimes compelled constructors to use but very little lime in their mortar and

the sand as they found it. The mortars in the construction of the cathedrals of Laon, Troyes, Chalons-sur-marne and Seez a are very bad. But we have given elsewhere the reasons, that caused those edifices to be erected with extreme economy. (Arts. Cathedrale, Construction).

MOSAIQUE. Mosaic.

Works made of little cubes of hard stone or of glass pastes of different colors, fixed on the surfaces of monuments or on floors by means of a cement composed of lime, very fine sand, pozzolana or pounded brick. The Romans of the late time employed mosaic not only for decorating floors of halls, but also for covering the walls. It is unnecessary to repeat here what has been written on this subject. It suffices for us to state that mosaic was very frequently used in the monuments of the M Merovingian epoch in the West. Gregory of Tours speaks of the mosaics that ornamented several churches of his time. S. Pallade, bishop of Auxerre in the 6 th century caused the erection of the monastery of S. Eusebe, the apse of the church was decorated by mosaics into which gold entered for a great part.[1] Indeed mosaic work, and which was given the name of Byzantine, is composed of gold grounds obtained by means of little cubes of gilded glass paste covered by transparent enamel. The subjects and ornaments are detached on these golden grounds. This sort of mosaic is very common in Italy, Sicily and the Orient, but very rare in France, since we know only a single example still existing in the little church of Germigny-les-Pres near Sully-sur-Loire, an example that appears to date from the 9 th century.

Note 1.p.403. Abbe Lebeuf. Mem. conc. l'hist. civ. et eccles. d'Auxerre. Vol. I. p. 149.

Abbe Lebeuf, in his Histoire du diocese du Paris,[1] says that in the castle of Bicetre built by the duke of Berry, brother of Charles V, there were two small rooms "enriched by perfectly beautiful work in mosaic." It is now difficult to form an idea of what this work could have been in mosaic of the 14 th century, since we know of no other work of the kind executed in France since the 12 th century. Yet we still possess in t the storerooms of the abbey church of S. Denis the remains of a mosiac pavement with gold ground and color dating from the

end of the 12 th century, and that perfectly recalls in manufacture the Italian mosaics of the same epoch. This pavement, whose entirety is preserved by a drawing by Percier made in 1797, represented the labors of the year surrounding a large compartment occupied by fanciful animals. If the fabrication be Italian, the design is evidently French. But it should not be forgotten that Suger, if we believe his acts, had invited artists from all countries to contribute to the erection of t the new church, begun in 1140. However, we cannot give to the cartoons, that served for the execution of the work, a date preceding 1190.[2] In removing from this same church of S. Denis the sad excrescences that so profoundly changed its character, we found under the modern tile floors a number of little cubes of glazed terra cotta 0.6 to 0.8 in. square, that evidently served for making mosaics by an economical procedure. In the 12 th century we architects sometimes sought to imitate those Italian floors known by the name of opus Alexandrinum; but the hard stones being wanting for them, they replaced these by glazed terra cotta. More commonly the tile floors of t terra cotta had inlaid drawings, or incised stone slabs replaced with us the old Gallo-Roman mosaics, or those of beyond the mountains. As for mosaics on walls, as we have stated, t there exist only a very limited number of them on this side of the Alps, and those precede the 12 th century. Stained glass was the true decoration of edifices in France from that epoch, and in fact stained glass is a sort of translucent mosaic. (Art. Vitrail).

Note 1.p.404. Vol. X. p. 16.

Note 2.p.404. There must be mentioned here the mosaic representing the figures of the zodiac discovered in 1831 at S. Omer, that come from the tomb of prince William, who died at Aire in 1109 (abbey of S. Bertin).

MOULIN. Mill.

Only occupying ourselves here with buildings containing a machine for grinding, for fulling, or for shaping metals, we have mills moved by a stream and wind mills. Water mills appear to be oldest. lambert, fortieth abbot of S. Bertin, caused to be established permanent water mills, begun under Odland in 797. Those mills according to the chronicle of the abbots

of S. Bertin were the first that were established in the country.[1] That abbot Lambert (1095 - 1123) even caused to be executed hydraulic works, that appear to have been quite important, since by means of the motor wheels of the abbey mills, he elevated the water necessary for the service of the monastery, so as to distribute it in the buildings by subterranean aqueducts. There is no mention of windmills in France before the 12 th century. Some authors claim that the invention of that sort of mills was brought from the Orient by the first crusaders; and indeed windmills were called Turkish mills in Normandy during the 14 th century. Charters of Philip August grant the right of establishing windmills and water mills,[2] and in the romance of Ogier of Denmark,[3] there are two mentions of water mills.

Note 1.p.405. See Abbes de S. Bertin, etc., by M. H. De la Place. Part I. 1854. p. 41, 186, 187.

Note 2.p.405. In 1195. Ducange. Gloss. (Latin note).

Old French poem.[4,5]

Note 4.p.405. Verse 6673.

Note 5.p.405. Verse 8249.

The Olim gives decrees of parlement relating to the establishment of windmills. We shall quote one of these decrees, r rendered in 1275, under Philip III.

"The monks of Royaumont complained that a windmill belonging to Pierre of Baclai had been recently erected near Baclai to their prejudice and damage, and to the injury of their mills of Gonesse; they demanded that this mill should be destroyed, when the stated that the lord king had said or ordered it by judgment. The reasons for the opposing parties having been heard, the decree was pronounced, the mill must not be destroyed, so far as the monks are concerned."[6]

Note 6.p.405. Les Olim. Vol. I.p.82.

In the 15 th century lord de Caumont, traveling at Rhodes and describing the edifices, that seemed to him remarkable in that city, expressed himself thus:- "and all along that (wall of the city) are placed 16 windmills, all in a row, that grind night and day in winter and summer. Old French).[7]

Note 7.p.405. Voyage d'outremer en Jerusalem, by de Caumont. 1417. published by marquis La Grange. 1858.

On the towers of the enner enclosure of the city of Carcas-

Carcassonne, there were several windmills, as shown by a vignette of 1467,[1] and by the old names of some of those towers.[2] Water mills belonging to castles or isolated abbeys were often fortified. The establishment of a mill could occur only by a grant of the lord of the manor. In granting the right to b build a mill, the lord assigned to him an area, the ban of t the mill. All the inhabitants comprised within this ban were obliged to have their grain ground in the mill of that area, uder pain of seeing their wheat, horse and cart confiscated for the benefit of the owner of the mill of the lord of the delinquent. Thus these mills became actual fiefs, whose preservation was important to the lord that had permitted their establishment, to the owner and to the inhabitants comprised within the ban; it was necessary for these buildings to be a able to resist a sudden attack and to defend themselves. Hence they were built on islands as much as possible, or indeed on a bridge easily barricaded. These mills were sometimes strong enough to sustain a regular siege, and so that their motor wheels could not be destroyed by stone-throwers or mangonels, they were then carefully protected by a masonry structure. T The mill called du Roi on the Aude at Carcassonne thus resisthe the attacks of the army of Trencavel in 1240. In his excellent work on Guienne militaire, M. Leo Drouyn gives several examples of water mills, that date from mostly in the 14 th o century, and that show with what care these works were established in the middle ages. The building containing the mechanism is nearly always square or rectangular in plan, the motor wheel being placed inside the length of one side of the parallogram. If no mills preceding the 13 th century exist, the te texts as well as the representations of those works can leave us no doubts concerning their establishment from the beginning of the 12 th century at least. One of the capitals of the nave of Vezelay shows us the machine of a mill, the men carrying g grain to the hopper. The manuscript of Herrade of Landsberg,[3] that dates from the 12 th century, likewise shows us the mechanism of a water mill having a motor wheel with blades, whose axle has a cogwheel and turns the lower millstone. From the time of William the Conqueror, says M. L. Delisle,[4] there had been established at the entrance of the port of Dover a mill moved by the flow of the tide.[5] "In 1235 one of these existed

at Veules.[6] In the 14 th century the archbishop of Rouen possed at Dieppe two tide mills." In 1277 Philip the Bold confirmed to William the Archer the tide mills established on the bridge of Ouve near Carentan.

Note 1.p.406. Imp. Lib.d'Etompes. No. 7402. Feb. 40.

Note 2.p.406. Mill of the constable, mill of Avar, mill of the South.

Note 3.p.406. Library of Strasburg.

Note 4.p.406. Etudes sur la cond. de la classe agric. etc.

Note 5.p.406. (Latin note). Domesday book, quoted by S. H. Ellis. Vol. I. p. 124.

Note 6.p.406. Cartul. of Fecamp.

There exist in France water mills of old date and that are still in use; they are found in Normandy, Touraine, particularly in Guinne, where these works are almost always fortified, and were established during the English domination, the epoch of prosperity and development for that province. At Melun before 1830 were still seen the ruins of a fortified mill belonging to ruins known under the name of the castle of queen Blanche. That mill, and where is now to be seen only the substructure, consisted of two thick piers with buttresses opposed to the current of the river and crowned by turrets; only the first courses of these were visible. The motor wheel was placed between these two piers and consequently was perfectly protected. The plan of the ground story, supported by an arch connecting the two piers, was probably only a rectangular room. We have not been able to procure any information concerning the upper part of this work. The construction certainly dated from the 13 th century, from consideration of the stumps of the turrets.

Here (1) is the plan of that mill at A and the remains of the elevation at B. We do not think that the downstream end was crowned by turrets, in fact nothing was to be feared there, the attacks coming from upstream (the mill being formerly surrounded by water). The floor of the ground story over the motor wheel was placed at the level C and at D was a wooden bridge supported on corbels, the entrance of the mill being at E. The mill of Bagas, Gironde, given by M. Leo Drouyn,[1] was built in the 14 th century,"in 1436," says that author, "120 years after its construction, it was given by Henry VI,

king of England, to Pierre Durant, squire." This mill is still running today. Here (2 X) is the plan of the mill of Bagas or Bagatz in the ground story, as it was established on a branch of the Drot. The dike that maintains the mill rase is at A. Two angles B, B' direct the water on two wheels C, C'. Downstream the water from the blades escapes through openings covered by lintels, and D is an islet. The entrances of the mill are at the upper and lower ends by doors covered by pointed arches (G and #). One can reach those doors only by the islet D, or directly by boat at the point H. That ground story is protected on three sides by 6 slots opening in each side of the upper end. By a wooden stairs one ascends to the second story X X. From the hill opposite the islet one comes nearly on a level to the door E by means of a drawbridge. By that door the grain is brought into the mill. This story is only one room, like the ground story, and contains a privy at F; a little door I formerly opened on a wooden gallery J, that probably extended along the lower end. One also ascended to t the their story XXX by a wooden stairs. That story is equipped at the four corners with turrets, one containing a stairs that ascends to the roof of the upper battlements. Four windows 1 light that room, also pierced by 7 slots and having a fireplace.

Note 1.p.408. In his book previously mentioned on Guienne militaire, p. 28. We cannot recommend too strongly the work of M. Leo Drouyn to our readers. One cannot find collected m more interesting data on the monuments of one of our beautiful provinces of France, nor rendered with more charm and o scrupulous appearance of those civil and military edifices.

Here (3) is the perspective view of this mill taken from t the point P.[1] M. Leo Drooyn, from whom we borrow these data, presents views and plans of several other mills taken in the same province and built during the 14 th century.

Note 1.p.409. The battlements alone are now destroyed. The other parts of the structure are nearly intact.

In the cities men often profited by the arches of a bridge for establishing mills, and even then the bridges and mills, built of wood, formed but one structure. Before 1835 there s still existed at Meaux in Brie a bridge of this kind entirely of wood as well as the mills belonging to it. that entirely dated from the end of the 1; th century. At Chalons-sur-Saone

the stone bridge communicating with the island was equipped with round towers on piers, with mills between those towers a at the arches; that picturesque arrangement has remained till the 17 th century.[1] At Paris the bridge au Meuniers (millers' bridge), that crosses the larger branch of the Seine below t the bridge au Change opposite the palace, was established in the same conditions as that of Meaux.

Note 1.p.410. See civit. orbis terrо. Folio. 2 vols. 1574. The view of Chalons-sur-Saone is found at the beginning of the fourth book.

We have not been able to find documents having any value o concerning the form of windmills of the middle ages, or rather on the arrangement of their upper part, for they consist of a round tower for the body of the structure. Yet the vignette cited above, and that gives a view of the city of Carcassonne in 1467, indicates one of the mills on the towers of the inner enclosure; now that representation recalls the mills of o our time! a conical roof on a round tower and four wings covered by cloth. At Castelnaudry 15 years since were still to be seen some windmills of the 16 th century, that did not differ from ours.

In the 15 th century there existed windmills on the hall o called des Moulins at Paris, situated between the present palace of the Tuileries and the boulevard; and on several towers of the wall of Philip August they had been established before that epoch. The celebrated tapestry of the city hall, that d dates from the second half of the 16 th century, exhibits around the capital quite a large number of windmills on elevated points.

MOUSTIER. Monastery. (Architecture Monastique).

NAISSANCE. Springing. Impost.

The starting poin of an arch on piers. In the middle ages the architects of the Romanesque epoch always raised the springings of arches above the bands or the abacuses of capitals. When those architects had to draw an archivolt on two columns A B (1); instead of taking the centre of the arch on the line a b, they raised this point, for example, so that a visual ray did not miss the springing of that arch by the effect of the

projection of the abacuses.

In Article Construction we gave the reasons that frequently compelled architects to raise the springings of arches. We can also referto it in Article Ogive.

NARTHEX. Narthex. Western Portico.

In the Roman basilica the narthex is the portico erected be before the nave and forming the back of the atrium. In the p primitive churches, the narthex was destined to contain the converts, and at the centre the penitent hearers opposite the door of the nave, i.e., those permitted to be present at the divine service outside of the church. During the middle ages the word narthex was not applied to the open or closed porches of our churches; further there were no longer proselytes or converts. Only since the beginning of archaeological studies that term of narthex has been applied to the closed porches of certain churches, like the porches of Cluny, Vezelay, Tournus, etc. We shall accept it, since we do not think that we should modify the vocabulary adopted by architects and archaeologists. It should noless be stated that the word narthex is not applicable to our religious edifices; it is replaced by the word porch.

There are also open and closed porches. The churches of the order of Cluny and those of the order of Citeaux all have more or less extensive closed porches before the nave. The porch of the church of Cluny was even a sort of very large ante-church, like those of the abbey church of Vezelay, Charite-sur-loire, S. Philibert of Tournus, etc. The distinction between open and closed porches often being very difficult to establish, we refer our readess to Article Porche for the study of that very interesting part of our religious edifices; the more that we cannot state why the archaeologists of our time have given to closed porches the name of narthex, while the true narthex was nearly an open portico, at least on its front side, in the first Christian basilicas.

NEF. Nave. Aisle.

The antique Roman basilica consisted of one or theee aisles terminated by a semicircle serving as tribunal, before which when space permitted, according to Vitruvius, was erected what

we call today a transverse aisle or transepts. The word nave thus signifies only that the hall is longer than wide, enclosed by two walls and a roof, or accompanied laterally by two lower aisles, supporting a gallery of a shed roof. In the first Christian basilicas, like S. Paul-without-the-Walls at Rome, the aisles have been carried to the number of five; a central nave and two side aisles on each side of the middle nave. Today the name of nave is not given to the side aisles, but only to the middle space, that is covered by ceiled carpentry or vaulted. The old church of S. Martin-des-Champs at Paris, now Ecole des Arts et Metiers, consists only of a single nave rebuilt about the middle of the 13 th century and terminated by a choir of the 11 th surrounded by a side aisle with chapels. The cathedrals of Rheims, Amiens, Rouen, Chartres, Bayeux, Coutances, Tours, etc., have a central nave with single side aisles before the transepts. The cathedrals of Pa Paris, Bourges, Cologne, the abbey church of S. Sernin of Toulouse, etc., have a central nave accompanied laterally by double side aisles. Until the end of the 12 th century, the naves of churches with side aisles scarcely exceeded 32.8 to 36.0 ft between the axes of the piers; but after the Gothic period, those naves attained 49.2 and 52.5 ft. between axes of piers. As for the churches with a single nave, like the cathedrals of Toulouse and of Alby (12 th and 14 th centuries), their inside width reached 65.6 ft. and more. (Arts. Architecture Religieuse, Cathedrale, Travee). The monastic churchsof the Jacobins, built during the 13 th century, were habitually composed of two naves of equal length, width and height; those twin naves are separated by a row of piers (Art. Architecture Monastique). That arrangement is also observed for halls devoted to monastic or civil uses, like the refectory of S. Martin-des-Champs at Paris, and the old great hall of the palace at Paris.(Art. Salle).

Our oldest French cathedrals were mostly cocceived with a central nave accompanied by single or double side aisles, b but without transepts. The cathedral of Noyon, among those e erected during the 12 th century, and that of Soissons, form the only exceptions to this rule. Not only those great churches contain no transepts, but they were without lateral chapels; scarcely some of them preserved three very small ones ope-

opening from the side aisle of the sanctuary. Excavations that we made in the cathedral of Sens, built as all know about the middle of the 12 th century, have brought to light the bases of the piers that extended to the middle of the existing transept, and when one knows that fact, he easily recognizes how in the 14 th century, transepts were added to that great church by destroying two bays of the nave at right and left. At Senlis is the same arrangement, the cathedral consists of a nave with side aisles and without transepts. The addition of the transverse aisle is easily recognizable there. The cathedral of Meaux, which dates from the end of the 12 th century, was originally without transepts. Even at Paris, holes made in the extension of the piers of the choir and bays remaining visible in the spandrels of the great vault of the crossing, lead us to believe that this church was also conceived without transepts. Finally at Bourges, whose construction dates b back to the first years of the 13 th century, but whose composition in plan is earlier (Art. Cathedrale), there existsno transepts. Then one can conclude from these facts, that the programme of the French cathedral of the 12 th century, given at the moment when the bishops united the efforts of the communes and commenced those grand structures, only required a c central nave with side aisles, without transverse aisle, crossing or transepts, and even frequently without chapels. The French cathedral was thus only a hall, a basilica; a place of assemblage for the citizens, at the centre of which was the altar and the throne of the bishop, the cathedral. Let us again state, that in most of these edifices, at Paris, Senlis and Meaux, upper galleries were arranged like the alleys of the second story of the antique basilica. A text supports this fact of the absence of transepts in the cathedral churches rebuilt at the moment when the art of architecture passed into the hands of laymen.

In his Rational, William Durand in describing the different parts of the church (Chap. I, sect. 17) says:- "Certain churches are built in the form of a cross," and in taking in a mystical sense each part of the church from choir to the porch, he does not mention the transvesse aisle. Now since he states that "certain churches" in his time were not in the form of a cross, it cannot be doubted, that some existed without them,

and William Durand, bishop in 1285 and dead in 1296, had then seen several French cathedrals without transepts. The minute attention with which that celebrated prelate sought to give a symbolical religious signification to the various parts of the church further indicates the tendencies of the higher clergy at the epoch when he wrote. It then concerned the erection of a cathedral, built by the aid of circumstances rather political than religious, the civil character that it retained in the minds of the urban people; and for us the establishment of the transepts, of the lateral chapels and the enclosures of the choir, during the end of the 13 th and beginning of the 14 th centuries; consequently the destruction of the great primitive naves of the bishops' churches of the first Gothic period, in that i indicates the communal movement urged by the bishops in the 12 th century, because they hoped to profit by it to ensure their power, and the clerical reaction against that movement, when the royal power had firmly established itself, and the episcopate must renounce the subjection of French society to a sort of theocracy.

NICHE. Niche. Recess.

A recess of small depth made from the face of a wall, pier or buttress, for placing a statue. Niches are not common in the architecture of the middle ages; they are not seen in the edifices of the Romanesque epoch, and they appear only at the beginning of the 13 th century. We cannot give the name of n niches to arcades filled by round figures, for example like those decorating the facades of Notre Dame la Grande at Poitiers or of the cathedral of Angouleme.

The architects of the middle ages had not thought of placing on the surface of a wall a recess without any motive other th than to receive a statue. The taste and good sense with which they were endowed did not permit them to employ these means of decoration, that could only be compared in architecture to t the useless lines placed in their verses by certain poets. The Roman architects of the empire used and abused even the niche, but the system of their construction lent itself to that. In order to lighten the enormous masses of masonry in the Roman structure, and to economize the materials, niches were made in the solid masonry, that after all were only recesses with

discharging arches. The horizontal section of these niches w was either a semicircle or rectangle, and in this sort of cell was placed a statue. But in the architecture of the middle a ages the solids having only the section necessary for their function, there was no chance to lighten them by voids. Thus niches appear only at the tops of buttresses, i.e., where the construction having nothing more to bear, it is well to give it a light appearance. Actual niches are seen at the tops of the buttresses of the nave of Notre Dame of Chartres. Others are also seen to form the tops of some of the buttresses of the nave of the cathedral of Rouen (beginning of the 13 th century). (1). Sometimes though rarely, niches are placed on the buttress beside the portals and to connect the great statuary of the splays. But these niches are not made in the mass, but form a projecting frame around a statue. One of the m most beautiful examples of this sort of niche is seen on the facade of the cathedral of Paris, at the height of the springings of the arches of the three portals. The buttresses receding above those imposts, the architect has profited by the lesser projection to crown it by a projecting band supporting two little monolithic columns surmounted by an arcade, covered by the slope of the recession. Those four niches that participate in the decoration of the doorways are filled by four figures representing S. Etienne, the Church, the Synagogue a and S. Denis. We give (1 bis) the niche containing the personification of the Church.[1]

Note 1.p.415. This statue was destroyed at the end of the last (18 th) century, and has been restored by M. Geoffrey-Dechaume. It is one of the best statues of that distinguished artist. The Synagogue forming its pendant is by M. Fromanger. The statue of S. Denis is by M. Pascal, and that of S. Etienne by M. Chenillon. Another niche on the return is seen on t the south side; it shelters the statue of S. Marcel, from the chisel of one of our best statuaries, M. Toussaint, recently deceased.

We cannot regard as niches the pinnacles that cover the buttresses of the cathedral church of Rheims (Art. Pinacle). But around the choir of the cathedral of Mans the faces of the b buttresses at midheight are lightened by niches containing s statues (2). (About 1250). One will note that these niches a

allow the face of the buttress to pass, and are only an arch in regard to that face. The statues being set on a projecting plinth, the niche is only a frame enclosing a statue projecting from the face of the structure.

Thus are always treated niches until the end of the 13 th century. At the beginning of the 14 th, niches are decidedly made at the expense of the surface; they form a recess. Thus are treated the niches arranged on the exterior between the windows of the great chapels around the choir of Notre Dame of Paris (L·325). Again there the statues are placed on pedestals that are behind the external surface; they are twin, i.e., that two personages are always combined. Et seems that the architects of the middle ages thought only that isolated statues placed in niches could produce a happy effect; they took care to combine them at least in pairs. Besides those niches around the choir of the cathedral of Paris form a continuous decoration wit the windows; they participate in the entirety. On both sides of the southern portal of that cathedral,church, a portal dating from 1257, one likewise sees niches arranged in threes, that continue the series of statues placed in the splays of the portal. Fig. 3 gives the arrangement of those niches, that we have traced in plan at A.

In the interior of that portal on the south wall of the transept exist actual niches between the gable of the central portal and the two lateral ornamental gables. Those niches (1257) are very shallow and are surmounted by high canopies as if to indicate a prominent point and not a recess, and the statues are still supported on pedestals.

It was only in the 15 th century that were made isolated n niches, that could be regarded as such. One sees them at the angles of facades of certain houses of that epoch; but 1 likewise they are always surmounted by a canopy, and the statues rest on a corbel. (4).[1]

Note 1.p.419. From the house called that of the queen of S Sicily at Saumur.

All these examples do not have the character of the niche, as it was understood after the 16 th century. On the facade of that house of the Musicians at Rheims (Art. Maison, Fig. 11), the piers between the windows are slightly hollowed like niches terminated by a segmental archivolt; but the seated s

statues project strongly, and rest on corbels, presenting a pronounced outline on that facade, and form an entirety like the combination of figures participating in a scene; far from appearing as each in its niche, they rather seem to be in concert. Also on the lower parts of certain facades of churches, in the splays of porches, one sometimes sees a series of niches crowned by canopies. But the statues that fill these niches jostle each other and form a continuous band of figures, and so one cannot regard them as being placed in niches.

Like true artists, the sculptors of the middle ages rarely adopted an isolated statuary. For them as for the Greeks, statuary was the development of an idea, a series, and it was but exceptionally, that they allowed the single figure. (Art. Statuaire).

NIMBE. Halo.

A halo in the form of a disk, that accompanies the heads of divine personages and of saints. M. Didron in his Iconographie chretienne,[1] has devoted a long chapter to the history of the halo in the monuments of the middle ages. We can add nothing to that learned essay, to which one must necessarily refer w when it concerns the sculptuse or painting of our old edifices. (Arts. Statuaire, Peinture).

Note 1.p.420. Paris. 1843.

NOUE. Valley.

A rentrant angle formed by two intersecting slopes of roofs. Valley rafter denotes the timber of the carpentry, that supports the rafters of the two slopes of the roof that intersect. In the old carpentry composed of trussed rafters, the rafters assemble on the valley rafter. (Art. Charpente).

NOYAU. Newel.

A cylinder of stone or of wood rising from the bottom end forming the axis of a screw stairs. Newels are solid or hollow, attached to the steps or independent, in the last case supporting them by omeans of mortise or rest. (Art. Escalier).

OEIL. Eye. Round Window.

This name is given to circular openings pierced in gables,

and which are intended to give air and light in the roofs.

Bosses with large round openings, that in vaults allow the passage of bells, and that habitually take the profile of the diagonal arches are also sometimes called eyes or lunettes. (Art. Lunette). The eye or oculus of the primitive Christian basilica is a circular opening with internal splay, that was pierced in the front gable wall above the carpentry ceiling. The trace of that tradition is still found in certain Romanesque churches, especially south of the Loire. The Gothic rose window is the development of the eye of the primitive basilica. (Art. Rose).

OGIVE. Pointed Arch. Diagonal Arch. Cross Vault.

Quite improperly the name of "ogive" is given to the figure formed by two circular arcs intersecting at any angle whatever.[1] Many pages have been written on the origin of this word, and party spirit mingling with it (party in art matters is meant), men have so fully confused the matter, that any conclusion seems to have been postponed till calmer times. We first declare that we do not pretend to give here a solution, that farther it matters very little; it will suffice for us to furnish to our readers the data that we have been able to collect on the adoption of that form in architecture after the 12 th century in France, statements whose accuracy can be verified on the monuments themselves. As for the conclusion, we shall leave to everyone leisure to deduce it.

Note 1.p.421. "Croix d'augives" at the beginning of the 14 th century signified the diagonal arches of a Gothic cross vault. Now these "croix d'augives" or "arcs ogives" are most frequently found arches. "Item II crois d'augives to form the vaults above and an arch between II crois d'augives." (Foundation deed of a chapel at Averdoin, June, 1347. Archives of duke de Luynes. See Vol. II of Annales archaeologiques, p.41, Article by M. Lassus on "arc ogive.") During the middle ages and till the 16 th century, the words "ogive or augive, arcs augives" were applied only to crossed ribs. The other arches if pointed, were termed "arc doubleau, tiercerons, formerets. (Arts. Arc, Construction).

Compasses having been invented, the intersections of circles were obtained, and consequently the figure called the pointed

arch. It is not the origin of the figure that it is important to seek, but the origin of its application to construction. F From the monuments of Asia, Greece and Italy of very high antiquity, we are shown pointed arches, i.e., tunnel vaults or cavities (for example like that of the treasury of Atreus), whose section is given by two intersecting circular arcs; but all those monuments without exception present horizontal jointing, i.e., the beds of the stones forming these tunnel vaults or cavities are horizontal and not normal to the curves. But this is an essential point for architects, for one cannot give to these concave surfaces the name of arch or vault. Let us then abandon this origin that teaches us but one thing, to know that when it is necessary to cover a passage or a hall, there were given during the primitive epochs mentioned, various forms of corbellings, the sole means adopted to arrive a t that result. Recessions, inclined planes, curvatures, these a are always corbellings and not vaults, and the pointed form is merely a caprice of the constructor, not a system. The Etruscans indeed built true arches, i.e., composed of voussoirs with joints normal to the curve, and the Romans who built arches, tunnel and cross vaults, and hemispherical domes, never adopted the pointed arch, or if they did do so, those are the exceptions too rare to derive conclusions from them. The Romans accepted only one curve as generatrix of the vault, which is the semicircle, what is called the round or the segmental arch. From Augustus to Constantine,is no exception to this m method. It is only in the 6 th century that we see the pointed arch on the shores of the Mediterranean, in Egypt at Cairo; and there it already appears as the result of calculation. In another work we have explained in a detailed manner how the a ancients employed the triangle to place their edifices in proportion;[1] how among those triangles they adopted three:- 1, the equilateral triangle; 2, the triangle erected on the diagonal of a pyramid with square base, whose vertical section t through the vertex parallel to one side of the base is an eq equilateral triangle; 3, the triangle whose base is 4 with a height of 2.5 taken vertically at the middle of that base. Th These three triangles give at the vertex an angle less than 90°; thus it is possible to inscribe them in a semicircle. The last of these triangles, that on which was drawn the pyramid

of Cheops, and which passed among the Egyptians as derived f from the perfect triangle, according to the statement of Plutarch,[2] is then that at A (1); a b being divided into 4 parts, on the perpendicular erected at the point c at the middle of the base, we lay off 2.5 parts c d; joining the points d and a to b, we obtain the triangle a b d. From the middle of one side b d erecting a perpendicular to cut the base at e, e is the centr of the arc b d′d, of which the side b d is chord; proceeding similarly for the side a d, we have traced two arcs intersecting at the point d, and that compose what is termed a pointed arch. Taking the triangle a b d as the generator of proportions, i.e., as giving a satisfactory relation be between the base a b and the height c d, it was natural to r retain this relation between the span and the height of the keystone of the arch. By following these methods proceeded t the architects of Alexandria, from the 6 th century of our e era, and the school of the Nestorians, that soon arose to a remarkable degree of splendor among the peoples of the Orient, fathers of the architecture to which is given the name of Arab. The genius of the Greeks found itself again in this principle of the proportion of arches, as we have demonstrated elsewhere.[3]

Note 1.p.422. Neuvieme Entretien sur l'architecture.

Note 2.p.422. Traite sur Isis et Osiris.

Note 3.p.422. Neuvieme Entretien sur l'architecture.

The equilateral triangle (Fig. 1 at B) is also a generator of the diagonal arch; but it was only employed much later, w while the triangle taken on the diagonal of a square pyramid, whose vertical section through the vertex parallel to one side of the base gives an equilateral triangle, and was adopted very early for tracing the pointed arch. Let f g h be one half the horizontal projection of a square pyramid, whose vertical section on i k is an equilateral triangle; the vertical section on the diagonal f h gives the triangle f h l. Erecting a perpendicular m n to the middle of one side h l of this triangle, the point n at the intersection of this perpendicular with the base f h will give the centre of the arc h o l. Tracing from the point l as vertex an angle equal to the angle l′f g, so that the line l p divides this angle into two equal angles, we have the two sides l g, l r of an equilateral triangle; prolonging the traces of the arcs l o t to their inter-

intersection with the sides l r, l g; g r l is an equilateral triangle whose sides g l and r l are chords of the arcs l o r, l o'g. The pointed arch g r l is a horseshoe arch; it gives a greater span f h between the two arcs, the proportion of the triangle f h l, and at its springing q r, the proportion of the equilateral triangle q r l. The faces of the piers of that arch will be at s and t, i.e., in the verticals through the two points f, h. This form of horseshoe arch was frequently employed in the monuments of Persia, and is found already adopted for the construction of the porticos of the mosque of Amrou at cairo built about 640, with some variations in the mode of tracing. But the architects of the school of Alexandria and the Greek artists, leaders of the peoples of the East after the 5 th century, did nothing more than to give the pointed arch a method of drawing to satisfy a delicate feeling for proportion. Although in the construction of these arches the joints of the voussoirs were normal to the curves and tending to the two centres, as seen at X;[1] that consequently the construction accorded with the form, and all these pointed ar arches were more resistant than the round arch, while exerting a much smaller thrust, yet the oriental architects had not d discovered any other application of this new form, aud the system of vaults was not modified by it. It was reserved for the architects of north France to take possession of the pointed arch and to make it the starting point of a new construction, of an original art.

Note 1.p.424. The Italians have never understood the reasons, that caused the adoption of the pointed arch from the point of view of proportions and of its actual function. One can have proof of this if he observes that nearly all pointed arches are jointed like a round arch, i.e., that the joints of the voussoirs radiate from a single centre, which is nonsense; t that the proportions of these pointed arches nearly always present a disagreeable proportion between the base and the height. But the Italians of the middle ages did not comprehend much of Greek art after the late time, and the Greeks knew t this, for they regarded them as barbarians.

On pointed or round arches (for the orientals employed them simultaneously, although the pointed arch persisted more at Cairo and in Persia than elsewhere) were erected in the entire

East pendentives and spheroidal calottes, as in the first times of the empireof Byzantium, without seeking to derive from that new form of arch consequences of the nature to modify t the construction of vaults. With that inventive and practical genius that distinguishes the peoples of the extreme West, our architects from the beginning of the 12 th century, i.e., after the first crusades, took possession of the pointed arch and quickly made of it an application fertile in results. Until then in France only the Roman vault was known, and men strove to transform it without obtaining only rude attempts indicating a desire to satisfy new requirements much more than an advance. No longer constructing in concrete and rarely in brick, the Roman vault was only closed after numerous difficulties, only by the aid of experiments. The projecting groins of the Roman vault were built on a centering, and when it was desired to construct them of rubble, they offered no stability; the crowns were raised, and a compromise was sought between this form of vault and the dome, so as to give the l least possible projection to these groins,[1] that men did not know how to maintain between the parts of cylinders or of conoids thrusting outward. They tended always to the dome, and sought by means of permanent centres or by jointed groins from the beginning of the 12 th century to maintain the lobes of the vaults. These jointed groins (diagonal arches) were al - already a great advance.

Note 1.p.425. See the vaults of the side aisles of the c church of S. Martin-des-Champs at Paris; those of the side a aisles of the church of Poissy, etc.

The Cluniacs, who from the 11 th century were masters in t the art of building, and who had formed a school of architecture already brilliant at that epoch, were the first who knew how to apply the pointed arch to construction, not only of arches but also of vaults.[2] In constant relations with the East, they brought from thence the pointed arch; but it was only on French soil that this arch produced a revolution in the art of construction.

Note 2.p.425. The transverse arches of the church of S. Front of Perigueux date from the last years of the 10 th century and are already pointed.

In fact all Cluniac and Cistercian monuments built in Pales-

Palestine before the 13 th century, and so fully described by count Melchior de Vogue in his work on the Holy Land,[3] in adopting the pointed arch still retained the system of Romanesque construction, and in none of these edifices does the pointed arch intervene to modify the Roman cross vault, the tunnel vault or the dome. But as soon as introduced in the French provinces north of the Loire, the pointed arch combined with the vault and modified it. First see how the combination occurred. Let (2) be a hemispherical dome whose horizontal projection is presented in perspective; inscribing a square a b c d in the circle and erecting two vertical planes on the two diagonals a d, b c, the hemisphere is cut into four equal parts a b e, a c e, c d e, d b e. A vertical plane erected on a b will intersect the hemisphere in a semicircle a b f, and assuming this semicircle to be a round transverse arch, and repeating this on the four sides of the square, one will obtain a horizontal calotte penetrated by four cylinders intersecting at right angles and forming four pendentives. But if we desire to make of this calotte vault borne on pendentives a cross vault, instead of semicircles on the sides a b, b d, etc., we erect four pointed arches a b g, b d h, etc., connecting the crowns g h of these pointed arches with the point e, we detach from the calotte the diagonal groins a e, b e, d e, etc., and we obtain the curved surfaces a g e, b g e, etc., which can be portions of tunnel vaults generated by the pointed arches and giving by their penetrations in the vertical diagonal planes a d, b c, th semicircles a c d, b e c. Thus was already solved the essential problem, viz:- to be able to make cross vaults on all plans with generating arches of different heights and diameters. The Romans and Byzantine Greeks had not a attempted anything until then, except to cut th hemispherical vault by vertical planes, which section was always given only as a semicircle.[1] Our western architects proceed the same, only that having seen the pointed arch, then set in place of the semicircle given by the vertical section, and raised the sides of the dome on that pointed arch. Their operation is simple in principle and can be defined thus:- assuming a hemispherical dome of elastic material and flexible, making the four c cuts vertically over the sides of a square inscribed in the circle, one raises a little with the finger the upper part of

each cut; the surfaces remaining from the hemisphere follow that movement and form two diagonal folds, that vanish at the top of the calotte. To obtain such a simple result, how many centuries were necessary? [2] In the porch of the abbey church of Vezelay, built about 1135, we find an application of this principle already wise and reasonable.

Note 3.p.425. Les églises de la Terre Sainte, by count M. de Vogue. Paris. 1860.

Note 1.p.426. By the reason that every section of a sphere by a plane gives a circle.

Note 2.p.426. Other discoveries as simple in principle and fertile in results have taken much time to appear in this world; but rarely have those flashes of the human mind been regarded as a sign of barbarism. Rarely have peoples, in the midst of which new light has appeared, sought to dim its splendor.

Let us first take one of the vaults of the side aisles of that porch, vaults built on a square plan (3). The generating form of that vault is a hemisphere. The proof is that the two vertical planes passing through the diagonals a b, c d, give two semicircles, one of which is revolved down in a b d. To trace the transverse arches, above the line formed by the abacuses A of the capitals was taken the distance A B, so as to show the springings of those arches. The level line B C being drawn, the length of this line being d b the side of the square, this line was divided in four parts; erecting a perpendicular at the middle of this springing line, this perpendicular was divided into 2 1/2 parts, each equal to a division of the springing line. Thus was traced the triangle g h f. From the middle of each side of this triangle erecting a perpendicular e i, the intersections i of these perpendiculars with the line g h gave the centres of the pointed arch g f h. Joining the crown d′ of the vault with the crowns of the four arches, the cross vault generated by a hemispherical dome and by four pointed arches was constructed.

The principle being adopted, the consequences followed with prodigious rapidity. For the Roman architects, the great embarrassment was not to build vaults on a square plan, but on rectangular plans. In that case the Romans built tunnel vaults with penetrations, Welsh groin vaults, i.e., generated by

two intersecting cylinders of different diameters; the cylinders of the smaller diameter having their springings above t those of the cylinders of larger diameters, which produced a very bad effect. But when the dome became the starting point of every vault, this embarrassment must disappear. We have explained in Fig. 2 how from a hemispherical calotte one could make a cross vault on a square plan, by substituting pointed arches for the semicircular sections given by vertical planes erected on the sides of the inscribed square. The consequences of this innovation did not require to be waited for.

Let (4) be the dome on a circular plan with centre at A. The vertical section of that dome made on a diameter gives the p pointed curve B C D, whose rise A D has 2 1/2 of the four dividing the base. It is required to make of this vault presenting the form of a teat, a rectangular cross vault. Let the horizontal plan of that rectangular vault be the rectangular parallellogram B F E C inscribed in the circle. If the dome were hemispherical, the vault sections erected on B F, B E, w would give the semicircles B G F, B H E; but we fear the thrusts, and we have adopted the pointed arch as a means for making these thrusts less powerful, in order to conform to a system of proportions that satisfies us better than the round arch. We then divide the base lines of our sections B F, B E, into two equal parts, and taking the points I I', K K', as c centres, the lengths I F, I'B, K E, K B, as radii, we describe the two pointed arches B L F, B M E, pointed arches that are the revolved forms of the transverse arches on which will rest the vault. Hence the diameters B C, F E, whose revolved form is given by the pointed arch B D C, will become the diagonals, and the vault will be rather a cross vault than one given by the dome; further we shall be able to give to the arcs B F, B E, diameters whose relative lengths are arbitrary. By following this principle were constructed the high vaults of the porch of the abbey church of Vezelay. But let us first state an essential fact, that appears to have been neglected in the researches made up to this day on the theories of the cross vaults of the middle ages; this is that the making of the drawing at the moment of transition was not done for the intrados of the transveese or side anches, but for the extrados. In the example, of Fig. 3, the depth of the transverse arches

is independent of the drawing, it is laid off downward. It is the top surface of the vault to which men first sought to give a solid form, reasoned and lending itself to all combinations. The transverse arches are placed beneath it like a rib or a discharging arch intended to support structures over it. Thus the diagonal groins do not yet appear, their presence not being regarded as absolutely necessary,[1] while the vaults derived from the dome support themselves. Let us then see those high vaults of the porch of Vezelay.(5). The four piers being drawn, -- they are indicated by hatching,-- according to what we have just demonstrated in the preceding example, the diameters of the generating dome are the two diagonals A B, C D; the vertical section of this dome made on its diameter given by the (half) curve R E, the diameter having 4 parts and the rise 2 1/2. The extrados of the transverse arches starts from the points D B, the extrados of the side arches from the boints A B. That transverse arch being revolved is drawn thus:- the abacuses of the capitals being at the level G, so as to show them, the springings were raised to H. The base li line h i of the extrados was divided in 4 parts, on the middle k of this line being erected the perpendicular k l, it was m mad 2 1/2 parts, so that this rise k l may be to the base as 2 1/2 to 4. Establishing the triangle with side h l, erecting a perpendicular at the middle, the intersection of that perpendicular with the base line h i gives the centre g of the arc h g'l. Raising the springing line of the side arches by the height o p above the abacuses of the capitals, one proceeds the same as for the transverse arch, the base line A D of these side arches beiug to the rise p g as 4 is to 2 1/2. The vertical section on the great axis o t of the vault gives at S the crown E of the vertical section made on A B', at T t the extrados of the crown of the side arch, at l the extrados of the transverse arch. If we join the point T to the point S by a straight line, we can clear the groin projected in B X E; then we seek on the base line at s the centre of an arc passing through the points T S. That curve is the vertical section of the line F t of the crowns. As for the point l, it can be joined to the point S by a straight line, as shown by the vertical section V made on F P. The depth of the transverse i R b being fixed, it is found that the springing line R H comprised

between the intrados is divided in three equal parts by the points g and m, centres of the pointed arch. Then this arch is pointed. One then notes that the entire drawing is determined by the extradosses of the arches, that this vault is a c compromise between the dome and the cross vault, that the introduction of the pointed arch gives a great liberty to the c construction in the arrangement of the vaults on a rectangular plan, and that still the artist has carefully observed a principle of proportions, that he has regarded as good and n not without reason, since it results from the triangle to w which the ancients attributed a perfect harmonious value.

Note 1.p.428. These diagonal arches are called "ogives" in the construction of Gothic vaults. (Art. Construction).

An apparently purely material and minimum difficulty soon compelled the architects to make a new advance in the drawing of vaults and to extend the applications of the pointed arch. About the end of the 12 th century they commenced religious and civil edifices of dimensions unusual until t em. The widths of the great naves was carried to 49.2 and 52.5 and even up to 65.6 ft.[1] The art of architecture had then exclusively fallen into the hands of the laymen, and they soon comprehended the entire benefit to be derived from the new system of vaults. With that logic that characterizes the inhabitant of Gaul, the masters of works recognized, that since only two d diagonals are retained from the dome, or two sections made on the diagonals of a parallellogram inscribed in the circle, the base of that dome, it was frankly necessary to give to these two diagonal arches a useful and indispensable function; it was essential to make them the skeleton of the vault, and to rest on that skeleton compartments independent of each other, thus being able to incline in any direction, to be skew, to elongate, to become very concave or almost flat. The vaults of the cathedrals of Paris and Senlis, those of many churches of Ile-de-France built from 1160 to 1200, already present a number of combinations, that indicate how much the lay school emancipated itself in a very few years, while retaining the primitive principle derived from the dome of the pointed arch. Yet, -- for however rapidly they progressed, there are always transitions between the point of departure and the point of arrival, -- the dome regarded as generatrix is a trad-

tradition so powerful, tha for the construction of the great vaults, the architects did not yet dare to trust themselves entirely to the results of the system, that we have just indicated. They still had in mind the shape of the dome and they groped.

Note 1.p.431. Nave of the old cathedral of Toulouse.

The high vaults of the choir of the cathedral of Paris, which were completed before the year 1190, supply us in that respect with a subject of interesting studies. The date of their construction is certain, and they have not been modified later, as occurred for most apses of the 12 th century.

The memory of the dome evidently inspired the drawing of t these vaults (6). A circle with centre at C and with radius C A was first drawn. This circle was divided into 9 parts. F From the points 2 and 7 were drawn two lines parallel to the main axis A A'. These two lines 2 B, 7 D, are the faces of t the walls of the high choir above the piers. One sees that the two circular segments 2 3, 6 7, project beyond the faces of t the two walls. The points 2 and 7 have been joined by a line, that is the horizontal projection of the transverse arch of the sanctuary. Lines E 3, E 4, E 5, E 6, connect the middle of the transverse arch 2 7 with the dividing points of the circumference, and are the horizontal projections of the diagonal arches, ribs of the vault of the sanctuary. The lines 3 E, 6 E are prolonged to intersect the face lines 7 D, 2 B, and are the horizontal projections of the branches of the diagonal arches abutting the radiating arches. A line F G perpendicular to the main axis and tangent to the circle, gives the h horizontal projection of the last transverse arch of the great cross vaults. Having taken on the main axis a length 9 H equal to 9 E, one obtains the centre, the crown of the cross vault F G D B. But just as the triangle 3 E 6 is divided by the transverse arch E 7, they have thought to divide the triangle D H G by a transverse arch H I K. So much for the horizontal projections. For drawing the arches, the method followed is t this:- -- the transverse arch B D, F G or 2 7, is generated by a triangle whose base is 4 and height 2.5. On the middle of that base or springing line B D divided in 4 parts is raised the perpendicular a b. This has 2.5 parts equal to each 1 division of the base, and the triangle B D b is drawn. Laying

off on the base line from D to e a depth equal to that of the voussoirs of the transverse arch, the point e is joined to t the crown b. From the middle of this line e b, erecting a perpendicular as far as its intersection with the line B D, one obtains at tnthe centre of one branch of the transverse arch. As for the diagonal arches, that are the last remains of the dome, they are round as indicated by our revolution; their centre being raised to g above the abacuses of the capitals, so that the crown of the arches is found at a level higher t than that of the crowns b of the transverse arches, for they adhere to having a slope on the section of the vault from H to a. Therefore it was necessary for the crowns of the transverse intersecting arches I K to find themselves at the level of the crowns of the diagonal arches. Thus at p was raised the centres of the branches of this transverse arch revolved in o our Fig. The vertical projection of the transverse arch 2 7 of the sanctuary is exactly that of the transveese arches B D, F G. But as the branches of the radiating diagonal arches of the sanctuary must abut the crown E of that transverse arch 2 7, these branches are excentric, they are not radii of the circle whose centre is C; then the branch 3 E is shorter than the branch 4 E. Then is required a special drawing for each of these two branches. These traces are revolved in our Fig.; the crowns l and m of these branches evidently reach the level of the crown F of the transverse arch 2 7.

From all this it results that the groin arches G B, F D, F 6, G 3, and the branches 4 E, 5 3, are indeed sides of domes between which have been pierced side arches and transverse arches arsumiug a pointed carve. The architects even dared not yet to free themselves from the concave shape of the dome, although the system would have permitted this, for they took care to keep the keys of the transverse and side arches lower than those of the diagonal arches, so as to preserve to the structure that form of the calotte, that seemed to them necessary for stability.

The principle of the dome regarded as generatrix of cross v vaults appears to us too important no to insist on it. Thus (7) let this be an apsidal vault on a quarter sphere, whose plan is dotted at a a, the vault called "cul-de-four"(half dome), and so frequently employed by the Romans and during the

Romanesque period. Assume that we divide this half dome into 5 parts (see plan A), that reserving only the sides c b d, we remove between these sides the triangles e d b, e b b, etc.; we shall have the perspective Fig. traced at B. It is clear that we can vault these vacant triangles, either by means of a round side arch C, or of a pointed side arch D, whose crown E is lower than the crown F, or by means of a pointed side a arch with its crown G on a level with f. What we have indicated in a single Fig., several years were necessary to accomplish. The high vaults of the abbey church of Vezelay are built according to Fig. C; they date from about 1190. Those of the cathedral of Paris of the beginning of the 12 th century are according to the sketch D (1180). Those of the churches of the beginning of the 13 th century are according to the sketch G.[1] As the diagonal (round) arch b d is longer than the transverse arch c d, when they desired to have the crowns of those t transverse arches at the level of those of the diagonal arches, it was necessary to adopt the pointed form of the first, as seen at H. It is evident that on these sides retained from the dome, they have not dared to place all the weight of the compartments. The architects in leaving the crowns of the side arches at a level below that of the crowns of the diagonal arches, then thought to rest a part of the weight if the compartments or triangular fillings on the walls, and they were mistaken; but they soon recognized that this construction had its inconveniences; it tended to overthrow the side arches on outside. This was a compromise between the antique construction and that newly introduced, that was to arrest for some t time the developments of the art of the 13 th century; besides it was simpler to regard the arches retained from the dome as resistant points, and then to resis solidly the thrust by those sides: this is what was soon done:- 1, by adopting the pointed arch for the side arches. 2, by raising their crowns to the level of the crowns of the diagonal arches, as indicated by Fig. 7 at G.

Note 1.p.434. Burgundy is some years behind Ile-de-France, and the vaults of the choir of Vezelay correspond in construction to those (old ones) of the cathedral of Noyon, that date from the middle of the 12 th century.

The projections of the great vaults of the choir of the ca-

cathedral of Paris that we have drawn (Fig. 6) show us in B D F G a nearly square vault, composed of two diagonal arches B G, D F, two transverse arches B D, F G, an intermediate transverse arch K L, and four side arches B K, K F, D I, I G. Having the arrangement of the vaults on a square plan of the side aisles, points of support at B, K, F, D, I, G, on the one hand, and the tradition of the dome on the other, the constructors seeking to retain of that dome two diagonal sections B G, D F, on which must rest the fillings or compartments, they did not think that these diagonals must not intersect we very nearly at a right angle, if not exactly so. Thus then sp spanned two bays, resting these diagonal arches on the alternate points of support; but as much to lessen the surfaces of the fillings as to distribute their weight on all the piers, these constructors intersected this cross vault by the intermediate transverse arch K I.

Here then (B) is what that combination produced. The dome w with horizontal circular projection was still the generatrix of this vault. In fact (see the horizontal projection A), the diagonal arches ab, c d, are nothing more than sections reserved from the dome; only the walls of the nave being on the two parallels a d, c b, the intermediate transverse arch turned from the pier e to the pier f permitted vaulting each of the triangles a d g, c b g, by means of two compartments a e g, e d g, c f g, f b g. Instead of two side arches a d, c b, were obtained four side arches a e, e d, c f, f b. The perspective Fig. B explains this system. There the imaginary plan of the dome is visible. The two diagonal arches C D, E F, are its l last traces; the intermediate transvesse arch G H, instead of being a separate section of the dome, like the diagonal arches, has been transferred from G to G′ and from H′ to H; its crown attains the level of the crown I of the diagonal arches; then the skeleton being established, in the triangles remaining v void have been turned the compartments K′, that rest on the diagonal arches and transverse arches, and that are traced by the side arches L. This system also offers the advantage of admitting light laterally beneath the side arches in the height itself of the vault.

But it was scarcely logical when having points of support of equal strength at a e d, to support one transveese and two d

diagonal arches on the piers a d, while the pier e was only loaded by a transverse arch. They about 1230 was adopted a system of building the great vaults in very oblong bays, loading equally all the piers. Thus were constructed the high vaults of the naves of the cathedrals of Amiens and of Rheims; yet the dome is the generating principle as for the preceding vaults. In the cathedral of Amiens the diagonal arches are round or very little pointed, if necessary; but in that of R Rheims the generating dome of the diagonal arches is traced on an equilateral triangle, and the drawing of those vaults is as simple as profoundly reasoned.

At A (9) is given the horizontal projection of one of those high vaults; the piers being at a b c d, the axes of those piers give starting points of the two diagonal arches a d, b c, or rather the diagonal arches are the diagonals of a rectangular parallellogram, whose angles fall on the axes of the piers. These diagonal arches are the sections reserved from a dome, whose horizontal trace is given by the circle i j i′j′, and wh whose vertical section is the pointed curve k l k′l′, circumscribing a triangle whose base is to its height as 13:10. -- One notes that the curve is given by the extrados. -- The extrados of the diagonal arches revolved into e f g circumscribes an equilateral triangle; the extrados of the side arches revolved into h m n likewise circumscribes an equilateral triangle; the crown w of these side arches attains the level g of the diagonal arches, so that their springings are raised to m h. Those side arches are further the archivolts of the windows. Thus the results of the principle of the so-called Gothic cross vault rapidly become simplified. The drawings could already be indicated about 1230 by a simple formula. However th the equilateral triangle was rarely employed for tracing the great diagonal arches of vaults; it was rather adopted for t the side arches, whose springings were necessarily raised. (Art. Construction).

Villars of Honnecourt,[1] among his sketches traces Fig. 10, beneath which he inscribes the following legend (see text), which signifies; "By this means one makes three kinds of arches with a single opening of the compasses." Indeed with the r radius A B we trace the semicircle C B D. Setting the point of the compasses at C, with the same radius we trace the poin-

pointed arch A C E circumscribing an equilateral triangle. Dr Dropping from the point E a perpendicular to the base line, t the point F of intersection bisects the radius A C. Placing the point of the compasses at F, with the same radius we trace the arch G C R. The centers of the pointed arch G C H will be on the points F A, that divide the base C G into three equal parts. To this arch the authors have given the name of "tiers point." (Third point).[1] Now the architects of the middle ages did not always find areas sufficiently large to be able to trace completely the diagrams of the arches of their vaults at full size; indeed one understands that when it was necessary to erect a cathedral like those of Amiens or of Rheims, it would have been necessary for drawing at full size all diagrams simultaneously needed, an area larger than that occupied by the monument itself. They then forced to seek means for dr drawing and occupying little space, yet presenting rigorous a accuracy. The Album of Villahs of Honnecourt indicates several methods suitable for drawing voussoirs of arches without the aid of a diagram of the whole, and this lack of space for making the diagrams compelled the architects to adopt certain pointed arches traced according to a geometrical formula. T Thus these architects adopted by preference, after the middle of the 13 th century, three pointed arches:- 1, the pointed arch generated by the equilateral triangle; 2, the pointed t third-point arch; 3, the pointed fifth-point arch. The tracing of diagonal arches obtained by placing the centres on two points dividing the base, on three, four, five, six, seven or e eight, permitted the making of a rigorous diagram, without i its being necessary to draw the entire half arch. Let (11) at A be a pointed arch generated by an equilateral triangle; it is evident that the radius a b equals the base a d; that if w we trace the quadrant d o, the segment b o will be half the segment d b, since the equilateral triangle divides the circle into six equal parts. The crown b is then the third point of the quadrant divided in three equal segments; this is the reason that sometimes the name of "arc-en-tiers-point" (third point arch) is given to the equilateral arch, i.e., the arch whose crown falls on the third point of the quadrant divided in three equal parts. Let B be the pointed arch to which the name of third point should be applied in preference to any ot

other, the base c e being divided into three equal parts, that base can be divided in six equal parts, and the perpendicular dropped from the crown of the arch on the base will divide it into two equal parts; then the radius f e having four of those parts, the radius f g will contain four also. Now assuming th that to trace the diagram of the voussoirs of the pointed arch B, we have only the space f B g; the base c e being known, we take one sixth that we trace on B′f′ (Fig. 0); on the base B′f′ from the point B″we erect a perpendicular B″g′; then taking a radius f′g′ having four times the length of B′f′, which is one third of the half diameter of the arch, and placing the point of the "troussequin" (triangle ?) at f′, the intersection of the line f′g′ with the perpendicular B″g′ will give the point g′, the crown of the pointed arch. W can trace a portion of the arch g′i, give the depth of the voussoirs i k′and trace the joints to one of these voussoirs. All the voussoirs of the arch will then be given by this l m n o, and we can by this pa tern cause thousands to be cut. It remains to trace t the keystone or rather the half keystone, since pointed arches have a join at the crown. The prolongation of the perpendicular B″g′ will give us the pattern of this half keystone, as indicated in our Fig. But we still have another means of obtaining its pattern. (See sketch D). Let the line p q be the depth of the voussoirs; we divide it into four parts; drawing from the point g by means of a sector an angle q r s equal to the angle f′n t, we shall take on the q s a distance q v equal to one of the four parts of the depth line p q; we join the point p to the point v, and shall have traced the triangle p q v to add to the pattern to form the patter for the half keystone. To draw th pattern for the voussoirs of the fifth poin arch represented at G, one proceeds in the same manner; only the base of the arch being divided into five equal parts, we shall take 1 1/2 of those parts to commence the operation and take 4 for radius. It was then not by chance that the constructors of the middle ages in tracing their arches, took t the centres on the base or springing line of those arches, a and as proof that their method of drawing partial diagrams, one can observe that the voussoirs having been cut without k knowing exactly the number necessary for each branch of the arch, or the length of the soffit, it often happened in clos-

closing the arch, that was set a very wide half keystone or a last voussoir made thinner than the others.

Note 1.p.437. Album of Villars od Honnecourt. See the French and English editions. Plate XI.

Note 1.p.438. This name seems to us perfectly applicable indeed to that sort of arch, since the point of the compasses is placed on the third dividing point of the base. Still the equilateral arch is also frequently called third-point (in French). We shall see for what reason.

But a singular fig. drawn in the Album of Villars of Honnecourt, gives us the key to an entire system of drawing arches for an entire edifice, and as in the preceding example, allows the making of partial diagrams with rigorous accuracy, and without requiring very large areas.[1] Plate 39 of that Album shows us the voussoir of a third-point arch drawn according to the preceding method, and then a spiral intersected by a straight line passing through its eye. Above this sketch is read:- "By this means one cuts a voussoir of the fifth-point." The text does not refer to the drawing of that voussoir, but the presence of that spiral, drawn there as a simple memorandum, evidently relates to the drawing of arches generated by a division of the diameter into five. This sketch is reproduced exactly by the full line and our Fig. 12.[1] On a base A B divided into five equal parts giving six points, from the middle C as centre is drawn the semicircle A B. -- One will note that this point C divides the division 3 4 into two equal parts. -- Then taking the point 3 as centre and 3 A as radius, the second semicircle A 5 is drawn. Replacing the point of the compasses on C and taking C 5 as radius, the third semicircle 2 5 is drawn. Replacing the point of the compasses on 3 and taking 3 2 as radius, the fourth semicircle 2 4 is drawn. Finally, placing the point of the compasses on C and taking C 4 as radius, we draw the fifth semicircle 3 4. If from the two centres 3 and C, that have served for drawing the semicircles, we erect the two perpendiculars 3 a, C b, we cut those semicircles at a, c, b and d. Assuming that the diagonal arches of a great rectangular vault of the nave be the round arch of which A B is the diameter, the transverse arches having a base comprising four parts or the length A 5, those transverse arches consist of one branch of the arch A a and of a s

second branch of the arch 5 a, whose centre will be e, the m middle point of the part 2 3. The transverse arch will be drawn by means of two circular arcs, whose radius will be C A, and whose centres C and e will be dividing points of the diameter A 5 in eight equal parts. The diameter of the diagonal arch having five parts and the transverse arch four (see the horizontal projection H), the side arch will have three parts, for the side arch l m forming a right angle with the transverse arch l n, if we give to the base of that transverse arch 4, to the base of the side arch 3, the hypothenuse m n or base of one of the diagonal arches will have 5, because the square of 4 is 16, of 3 is 9, so that 16 + 9 = 25, which is the square of 5. Then A B being the base of the diagonal arch of a v vault whose transverse arch is A 5, the side arch will haveas base 3 B comprising three parts, and we shall have drawn the diagonal, transverse and side arches of the vault with the s same opening of the compasses; the dividing points of the base A B having given us at C the centre of the diagonal arches, at C e the centres of the transverse arch, at C f the centres of the side arch. Consequently the same circular arcs serving to trace these three arches, all the patterns of the voussoirs of these arches can be cut from a single diagram or part of a diagram, assuming that we apply the procedure indicated at D (11). If we wish to trace a narrower vault, i.e., a vault where the base of the side arches is half the base of the t transvers arch, we shall then have in horizontal projection the trace l p q n. (See Fig. 11). Then the diagonal arch n p will have for diameter 4 1/2 parts. That diagonal arch will then be pointed, a curve whose diameter is A f and centres a are the points 3 and C. The transverse arch will have as diameter as before A 5, and for centres e, C, and the side arch will have as diameter either 2 4 or 3 5, and for centres either e C or e f; in the first case this side arch will be drawn with a smaller opening of the compasses than that used for t tracing the diagonal and transverse arches; in the second, it will be drawn with the same opening of the compasses. If we divide the tympanum under the side arch into twin openings, each will have a part of the base A B or 3 4; and the centre of each of these arches whose crown is d will be at 3 and at 4, and that arch will be equilateral. If the side arch of the

rectangular vault l n m r, having for base 3 B and for centres C f, seems to us too sharp, we can substitute for it the arch whose base is 2 5, its crown is b and centres are 3 4. Thus o one understands, that by the aid of this Fig., the bases of a all the arches of a vault always giving equal divisions known thus as the radii of these arches, they can be cut by the aid of a partial diagram occupying a very small area. And indeed, if we examine gothic churches built during the 13 th century, we shall recognize tha all the diagonal, transverse and side arches, that the archivolts, bays and galleries, etc., are d drawn by means of centres placed on equal divisions into five or six of the diameter of the circle. It seems unnecessary to insist further on the importance of the spiral Fig. contained in the Album of Villars of Honnecourt, but it is not inappropriate to remark, that the rectangular vault l m n r, whose h horizontal projection is drawn at H, is derived from the triangle given by Plutarch as being the perfect triangle of the Egyptians, and that the transverse arch, whose diameter is A 5 divided into four, has a rise 3 a divided in 2 1/2 less a very small fraction, i.e., that it circumscribes a triangle very similar to that given by the vertical section of the great pyramid of Cheops. The pointed arch then merits some attention; it is not only a motive of stability that has caused its adoption, but also a feeling of proportion and of harmonious accord between all curves of the vaults; it is a necessity resulting from practice in tracing the diagrams; it is especially a need of liberty in the construction of these vaults, whose excellent principle one cannot too thoroughly study, s since it permits all combinations.

Note 1.p.441. The use of this Fig., that is not explained in the French edition of Villars of Honnecourt, is of capital importance in presence of the monuments. Do not forget that the old masters of works, building in very compact cities, c could not arrange workyards or areas of great extent. In theory one scarcely considers these difficulties, but in practice they have such importance, that they compel the architects that adhere to causing their diagrams to be drawn before them, to adopt methods that influence the forms adopted.

Note 1.p.442. The dotted lines, numbers and letters were p placed by us to explain the use of this Fig.

For twenty years have been made many imitations of Gothic c construction; these imitations very rarely satisfy the eyes; this indeed is because those that erect them, farther admiring much our old monuments, have probably never taken the trouble to seek therein the judicious elements. In architecture taste and feeling are much; but to depend on them it is necessary to use the compasses and geometry. One sees that by means of the firmula (12), there is but one of the pointed arches which has its centres outside its springings.

Indeed in those beautiful schools of Ile-de-France, Champagne and Soissonais, the architects as men of taste felt that the last limit of sharpness of the pointed arch was the equilateral; that the centres of the branches of the arch placed outside the springings give a pointed arlh, whose extreme sharpness is offensive, a disagreeable proportion, because the ratio of the base to the height exceeds the equilateral triangle. (Art. Proportion). But the Normans and Anglo-Normans we were less refined and sought in their construction before all else formulas, that assume simple practical means. Thus instead of attempting as in Fig. 12, to find pointed arches of d different spans having all angles equal at the vertex, or at least nearly similar, analogous ratios between the diameter and rises, these practical peoples of the North, good constructors from the beginning, were but moderately preoccupied w with proportional ratios and choice of forms; they desired an expeditious method. We have seen how Villars of Honnecourt g gave the means of drawing a round and several pointed arches with the "same opening of the compasses." Now the Norman vaults erected about 1220 frequently present an arrangement, such t that all the arches, diagonal, transverse and side, as well as archivolts, are drawn with the same radius.

Thus (13) let this be the horizontal projection of one of these vaults, the generating arch is the diagonal arch, that is round and revolved down in A B C. The transverse arch at C revolved in A C S is drawn with the radius a b equal to the radius O C. The transverse arch D E intersecting the diagonal arches revolved in D E F is traded the same with the radius e f equal to the radius O C, its crown F naturally being at the level C of the crown of the diagonal arches. Let i K and l m be the thickness of the piers, the side arches being comprised

between K and l. These side arches revolved in K l p are still drawn with a radius equal to the radius O C, their springings being raised from K to V, if it be desired that the crowns of the side arches attain the level of the crowns of the diagonal arches. If these side arches serve as archivolts for the openings divided by a mullion, still the radius n q equal to the radius O C will serve to draw the arches dividing the window.

Except for the keysones, the drawing of a single voussoir of an arch then suffices for cutting the patterns of all the arches of the vaults, archivolts, openings, etc. And (see the sketch G) if we divide a diameter of a diagonal arch into fou or six, with the same opening of the compasses, we can have a s ries of arches, whose diameters will be that of the semicircle, which is the greatest arch of the vault or the diagonal arch, as three, two or one are to four, or as nine, eight, s seven, six, etc., are to ten. Then having all the voussoirs cut on the same arc, and base or fraction of a base, we can without a diagram erect all the arches of an edifice. Then one comprehends the motive, that caused the adoption of the pointed arch called lancet; it was an economy of drawing, all complication of diagrams and patterns was avoided, and it was only necessary to give the section of each arch according to its function. Further, all being cut to the same curvature (on the extrados), they took their places according to the given designation. If diagrams were necessary, this was only for wooden centres, and again these arches were all traced by the aid of the same radius, the diagram of the semicircle or of the diagonal arch permitted the placing in line all other centres, since it sufficed to know the ratio existing between the diameters of these arches and that of the semicircle to have a o complete drawing of each, as shown by Fig. 13 at G.[1]

Note 1.p.446. By having to rebuild arches of Gothic vaults, we have been led to recognize this unity of curvature for many of them in the same edifice, whatever the spans of these arches, for the curves of the wooden centres cut for one served for several; only the segment of each branch was more or less long.

One can conclude from the preceding:- 1, that the pointed a arch was at first an importation from the Orient; 2, that being adopted in the East, as a curvature given by a principle of

proportion explained elsewhere,[2] this pointed arch in France was the starting point of an entire system of perfectly logical construction, allowing great liberty in application; 3, that consequently the pointed arch as a form probably belonged to the school of Alexandria and to the Nestorians, who appear first to have adopted it; but that as the principle of a new system of vaults, it without doubt belongs to our provinces north of the Loire, since in 1140 in the abbey church of S. Denis, the constructions erected by Suger allow round arches to appear only for diagonal arches, and that already is ap applied the system of vaults, that we see developed in the ca cathedral of Paris twenty years later. Now nowhere in Europe nor in the East in the middle of the 12 th century, were constructed vaults having some points of similarity, like the use of the pointed arch, to these of the church of S. Denis and of the cathedral of Paris. If then the pointed arch then originated outside France as a form of arch, we were first to apply it to one of the most fruitful inventions in the history of construction. If indeed the pointed arch started outside france, we were the first who knew how to derive from that f form, the result of a feeling for proportion,[1] results of considerab e value, since thew have produced the only original architecture, that has appeared since antiquity.

Note 2.p.446. In our Entretiens sur l'architecture. (9 th).

Note 1.p.447. See 9 th Entretien sur l'architecture et l' art. (Proportion).

ORATOIRE. Oratory. Chapel.

A little chapel erected on the site of an event regarded as miraculous, or to preserve a religious remebrance. The name of oratory is also given to certain chapels dependent on the apartments of a castle, palace or mansion. Wen still called oratories in the middle ages small tapestry chambers erected in the great chapels of castles, aud that were intended for t the castellans and their relatives.

In his Histoire du diocese de Paris,[2] Lebeuf mentions certain oratories built on the places where S. Germain stopped to pray or to instruct the people. The old abbeys possessed besides the principal church, oratories erected in several places in the enclosure. To perpetuate the memories recalled by very old oratories, in 1034 were rebuilt the little chapels if S.

Martial at Paris, that a fire had destroyed.[3] Most of the monasteries had their origin in merely an oratory erected in the midst of a desert and around which cenobites came to establish themselves. S. Clement thus built an oratory in a place called Gorze near Metz, that soon became the centre of a great monastery.[4] An oratory had been erected opposite the monastery of Sennoul to deposit there the relics of S. Simeon. When he retired in his oratory at Vienne in Dauphiny, archbishop Turpin or Tulpin learned the death of Charlemagne at Cologne from several devils, who had returned without having been able to carry off the soul of the emperor, they said, if one credits the chronicle of Richer. Charlemagne also caused to be built a great number of oratories, among which it is necessary to cite that of the valley of Moyen-Moustier, erected in honor of S. Denis, and in which was preserved the body of Pope Alexander, martyr, found at Rome. That oratory was paved with mosaic and existed till 1536.[5] At Cluny were still preserved in the last (18 th) century the oratories of S. Odilon and of S. Bernard; i.e., the isolated cells in which those personages habitually staid. It is well understood, that those little chambers were only remarkable ofr their extreme simplicity.

Note 2.p.447. Vol. I. p. 102.

Note 3.p.447. Lebeuf. Vol. II, p. 498.

Note 4.p.447. Chronique de Richer. Vol. II. Chap. 3.

Note 5.p.447. Chronique de Richer. Vol. II. Chap. 9.

Also certain oratories were arranged in the midst of fortresses in the middle ages; placed under the name of a saint e especially venerated in the province, and dopisitory of some of his relics, that protected the defenses.

Thus in the midst of the city of Villeneuve-les-Avignon, one still sees an oratory of the 12 th century preserved in the middle of an enclosure rebuilt in the 14 th century. Fig. 1 gives the plan of this little chapel, and Fig. 2 is its perspective.

Besides the chapel, common to all companions, castles had one or several oratories belonging to the apartments of the castellan and his wife. Those oratories were only small retired rooms usually placed in the tower. One shut himself in there to pray, but the divine office was not performed there. It was only in the 14 th century that the oratories of castles

became sometimes actual little chapels in which mass could be said.

In 1365 Charles V caused to be arrenged in the chapel of t the castle of the Louvre a very richly decorated oratory, so as to retire there when he disired to be present at the mass.[1] Mouis XI also caused to be built between two buttresses of the S. Chapelle at Paris the oratory from which he could see the altar through a little skew opening, without being seen by t those present. That oratory still exists, is covered by a tunnel vault and is very simple; it was probably hung with tapistries. On the contrary, the exterior is richly decorated by fine sculptures, and is terminated by a balustrade of Fleur-de-lises with a crowned L at the centre. An oratory is likewise attached to the S. Chapelle of the castle of Vincennes. (Art. Chapelle).

Note 1.p.449. Sauval. Hist. et antiq. de la ville de Paris. Vol. II. p.22.

ORGUE. Organ Front. (Art. Buffet).

OSSUAIRE. Charnel. Ossuary.

A covered structure built in cemeteries to deposit therein the bones found in the consec ated ground when new graves are dug. Formerly all cemeteries possessed a charnel. Sometimes, as at the cemetery of the Innocents at Paris, the charnel was only a cloister under the ceiling of which were successively placed the bones, that the great number of interments uncovered. On the walls of churches and even beside their principal portals were made recesses sheltered by one end of the portico of the cloister, and in these recesses furnished with f fixed gratings were thrown the bones abounding in the soil of cemeteries. An ossuary of that kind (1) existed at one side of the facade of the church of Fleurance. More frequently the charnel formed a sort of chapel pierced by a number of small openings, through which were perceived the bones gradually accumulated in the interior. Brittany still retains a very great number of ossuaries dating from the 15 th and 16 th centuries, and men have not ceased to deposit bones therein; some of these are filled to the roof. When the bones raised by the excavation of new graves belong to the dead that can be named,

the family encloses the skull of the deceased in a small box surmounted by a cross, and these boxes are placed on the sill of one of the numerous openings of the charnel. Fig. 2 represents a view of the ossuary of Faouet (Finisterre), that is attached to the church and looks on the cemetery.[2]

Note 2.p.449. We owe the drawing of this ossuary to M. Goucherel.

In the churches of the southern provinces, particularly in the Basque country, we have often seen on the exteriors of t the apses of rural churches surrounded by their cemetery, niches formed beneath the sills of the windows, in which are o carefully arranged the skulls gathered in disturbing the consecrated soil. Cellars made beneath certain parts of the church also sometimes served as charnels.

The desire to be interred the nearest possible to the church, when this could not be within their walls themselves, caused the tombs to approach the foundations "under the eave of the roof." Charnels were then habitually placed between the buttresses of the nave as if to satisfy the usual wish of the dying. This explains why the porticos of cloisters attached to churches were pierced by cells opened in recesses, a sort of cupboards on the side opposite the nave, in which were placed the bones brought to light by the sexton's spade; recesses or niches whose arrangement is given by Fig. 1. If charnels were built outside the churches, they were also necessary in the interior, for men would not wish to cast out the bones of the faithful uncovered inside. But some one must exhibit in the interior of the church only the remains of holy personages, the boxes from old and unknown interments were placed in little cellars, in certain parts of crypts, or as we have sometimes seen, in holes cut in the masonry and walled up. That custom was common among the religious, and we have discovered in repairing old walls of the abbey churches these walled recesses entirely filled with human bones, evidently coming from several bodies.

OUBLIETTES. Dungeon with trap in ceiling.

A deep excavation made under the floor or vault of a hall, into which were thrown persons, that were desired to disappear. There is no castle of the middle ages in which these are

not shown, and yet we must confess that we have very rarely found dungeons to which could be given this name; generally what are regarded as such are privies, whose use is easily recognized, however unfamiliar one may be with the art of construction. (Art. Latrines). We have seen in many castles, abbeys and official buildings dungeons, but we know only three "oubliettes," that may reasonably be regarded as such. The first is found in the castle of Chinon, the second in the Bastille, and the third in that of Pierrefonds. It must also be stated that the romances and chronicles of the middle ages often speak of dungeons, but never of "oubliettes." We should n not be indisposed to believe that those of castle Chinon are privies, which would reduce to two the examples cited. "We must w warn our readers," says M. Merimee in the Instructions du comite historique des arts et monuments,[1] "to beware of local traditions attached to the cellars of keeps. Men too frequently give atrocious colors to the middle ages, and the imagination accepts too easily the scenes of horrors, that the romancers locate in such places. How many cellars and storerooms for w wood have been taken for frightful dungeons! How many bones from kitchens have been regarded as the remains of victims of feudal tyranny! With the same reserve it is necessary to examine the dungeons designated by the name of "oubliettes," a s sort of well into which were lowered prisoners destined to die of hunger, or indeed they were slain by casting them from a high place, whose floor fell beneath their feet. Without placing absolutely in doubt the existence of "oubliettes," still one must regard them as very rare, and only accept them when such a purpose is well demonstrated." We are so much the more disposed to consider the "oubliettes" of castle Chinon as the pit of the privies, since the sort of well with square plan that forms it is pierced at about mid-height by a door, that seems to be the way for removal of the sewage, unless admitting tha this door was made to see if the condemned were already dead. As for the "oubliette" of the Bastile, it might p pass for an ice pit. Here is its section (1). It consisted of a hexagonal vaulted room located in the substructure of one of the towers, reached by a little door communicating with a screw stairs; all around that vaulted room was a walk 3.3 ft. wide, at the middle being an inverted cone ending in a little

opening intended to carry away water. It is certain that an unfortunate placed in the bottom of that funnel could neither sit, lie nor stand. It must be admitted that the little f flue was a soil pipe, and that persons lowered to the bottom of that cell were placed there to give them leisure to reflect. That was a sort of prolonged torture. But this case might be an ice pit, and it would not be the sole example of a storeroom for ice existing in a castle. Our ancestors loved cool drinks, and the little bottom drain is then well explained. As for the "oubliettes" of the castle of Pierrefonds, one cannot doubt their purpose, here is the section (2). They consist of a well excavated in the middle of a room, that was certainly a dungeon, since it contains a privy in a niche.

Note 1.p. 452. Coll. d. docs. ined. sur l'hist. d. France. Architecture militaire. p. 74.

One can descend into that dungeon only by a hole A pierced at the centre of its vault. He descends by a screw stairs from the ground story of the room C, that must also have served as a prison. To that room C is added a privy; it receives light only by a very small opening D. If the orifice of the "oubliette" remained open and was not closed by a trap door, one conceives the situation of an unfortunate prisoner always fearing to fall into that hole, that he could not see, since the dungeon received no light. The two openings, that of the vault and that of the oubliette exactly corresponded, and from the trap A one could cause a man to fall into the well without first taking the trouble to lower him into the oubliette. We have descended to the bottom of this oubliette; we found the wheel that served as foundation, but no trace of a human being. At B is the level of the bottom of the ditch. By excavating 6.6 ft. we made of it a well that supplies water for the needs of the castle. In the same castle exist other dungeons like this, except the well of the oubliette; in one of these dungeons we found names incised and rude sculptures on the surfaces. It is claimed that at the chateau of Blois also existed "oubliettes", but we have not been able to verify their form accurately.

OUVRIER.. Workman. Mechanic. Artizan.

What was the situation of the workman on buildings in the

middle ages? That question is difficult to solve. Before the regular establishment of guilds about the middle of the 13 th century, was the workman free like those of our time, or did he form a part of a corps, obeying statutes and subject to a sort of jurisdiction exercised by his peers? The stonecutters' marks that are found on the stones of the walls of our monuments of the 12 th and the beginning of the 13 th centuries in Ile-de-France, Soissonais, Beauvoisois, a part of Champagne, Burgundy and the provinces of the West, evidently prove that at least the working stonecutters were not paid by the day, b but by the piece. According to the mode of construction of th that epoch, the surface stones were rarely through stones, and were merely slabs of nearly equal thickness, the stone masonry being paid for to the master of works by the superficial toise (41 sq. ft.), and the cut stone including beds and joints by the toise to the workmen. Thus he marked each block on its v visible face, so that one could estimate the value of the work that he had done.

It must indeed be admitted that the workman were free, i.e., that he could do more or le s work, could be engaged or leave the yard as practised today. But about the middle of the 13 th century, when the regulations of Etienne Boileau were put in force, this mode of working must have been modified.

The workmen must first submit to the statutes of the guild of which they formed a part; the wages were regulated by the masters, and each affiliated master could have only one, two or three apprentices under his orders, thus becoming in relation to the master of works what we now term a journeyman having with him one or more helpers.

Then the wages were regulated by the day's work of the journeyman and helpers, and each journeyman thus became a sort of partial contractor combining in the general undertaking, on account of a wage agreed on and regulated for a certain part. Thus the stonecutters' marks are no longer seen on our monuments of the provinces of the royal domain after the middle of the 13 th century.

The master of the works, charged with the conception and direction of the work, found himself at the same time the regulator of the wages, assigning just as we do today, a certain portion, vault, pier, part of a wall, to a certain journeyman.

This explains in the same edifice those differences in execution noted in a pier or vault, from one bay to another, certain variations in mouldings, etc. The materials being supplied by the owner, they were delivered to each journeyman after having been laid out by the master of works, for he was necessarily a stonecutter.[1] The system of construction adopted by the architects of the middle ages compelled them to place themselves in direct relations with the workmen. And again today one cannot proceed otherwise when he desires to apply it. It naturally resulted from these continued relations between the orderer and the executor that a stamp of art is very strongly impressed on the least part of the work, like the expression of a single thought between the mind that combined and the hand that executed.

Note 1.p.455. All representations of the masters of works in the middle ages show them with the great compasses of the stonecutter in hand. If we state that the master of works was necessarily a stonecutter, it is indeed that the system of so-called Gothic architecture being adopted, it is necessary for the architect himself to trace the diagrams for the different members of his edifice. This fact alone explains why this system of construction is rejected, as unworthy of our civilized condition, by the masters of works of our times. Al Altogether, the trade of stonecutter is a very hard one.

We have changed all that, and in our time the intermediaries between the architect, who works in his office, and the workman that cuts the stone, are so numerous and know each other so little, that the execution is only an effaced imprint of the conception.

We are certainly civilized men, but we should be more so, if instead of manifesting a profound disdain for the institutions that we know badly, and that give us some trouble to s study, we should attempt to profit by them. Thus it is very certain that in the middle ages between the master of the work and the workman was not the great distance, that now separates the architect from the final executors; it would certainly not be the architect, who would find himself placed lower on the steps of the intellectual ladder, but indeed the workman would reach a higher step. To speak only of masonry, the manner in which the diagrams are understood by the stonecutters, the i

intelligence with which they are executed, indicates among t them a knowledge of descriptive geometry, of the intersection of planes, which we have great difficulty in finding in o our time among the best stonecutters. The material execution of the cutting always attained a great superiority over that we obtain on the average. But if we seek higher tradesmen, f for example sculptors, the carvers of images, it takes many years and infinite care to train workmen able to rival those of the middle ages.

In our time the carpenters form the only body, that has retained the spirit of the workmen of the middle ages. They are organized and have retained initiative; but the carpenter does not wish this. They are united on the yard, very submissive to the knowledge of the chief, when they have properly recognized him, but perfectly disdainful for his incompetency if that is proved, which does not take long. And among building workmen the carpenters, who have known how to maintain their ancient organization are an average of the most intelligent and best instructed.

Men have occupied themselves with the workmen for several years; thinking to ensure their well-being, to find asylums for their old age; the material side of their existence is sensibly improved. But for the building, men are perhaps not sufficiently occupied with their instruction, with improving the methods. The system of competition certainly presents great advantages and also has its inconveniences; it tends to debase the workmanship, to cause the employment of incapable men in preference to skilful men, because the former accept lower conditions of wages, or indeed because they perform in less time and more badly, it is true, the required work. That is not a means of improving the moral condition of the workman. The work yards opened at several points in France for the restoration of our old edifices of the middle ages have been nurseries of skilful workmen, because in those yards perfection in workmanship is a condition inherent in the work. All that is to be considered, but what is necessary is instruction for the building workman; the system of guilds exists no longer, and it would be necessary to replace it by a system of applied instruction. While waiting, the architects on their work yards can exert a very salutary influence on the work-

workmen that they employ, if they will take the trouble to o occupy themselves directly wit the work entrusted to them, a and if the do not disdain themselves to explain to them the means most suitable for obtaining perfect execution.

End of Volume VI.

TABLE OF CONTENTS

RATIONAL DICTIONARY

of

FRENCH ARCHITECTURE

From XI to XVI Centuries

By

EUGENT EMANUEL VIOLLET-LE-DUC

Government Architect

Inspector General of Diocesan Edifices

Volume VII

From Palais to Puits

PARIS

Translated by N. Clifford Ricker. D. Arch.

Emeritus Professor of Architecture

UNIVERSITY OF ILLINOIS

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PALAIS. Palace.

House of king or sovereign, the place where the sovereign renders justice. Thus what particularly distinguishes the palace from the basilica, the great hall that in fact is always the principal part. In the middle ages the palace after the Carlovingians is situated in the capital of the sovereign, a and is his residence until about the 14 th century. Yet the Merovingian kings possessed palaces in the country or near t the cities. Those first palaces were nearly erected on the m model of the Gallo-Roman villas, even sometimes in the ruins of those establishments. The palaces of Verberie, Compeigne, Chelles, Noisy, Braisne, Attigny, were only actual villas.

"The royal habitation had nothing of the military appearance of the castles of the middle ages; it was a vast building surrounded by porticos of Roman architecture, sometimes built of wood polished with care, and ornamented by sculptures, that did not lack elegance. Around the principal building were a arranged in order the lodgings of the officers of the palace, either barbaric or Roman in origin, and those of the chiefs of the band, that according to the Germanic custom were in t the trust of the king, together with their warriors, i.e., u under the special agreement of vassalage and fidelity. Other houses of less important appearance were occupied by a great number of families, whose men and women practised all sorts of trades. Most of these families were Gaulish, born on the portion of the soil that the king had assigned to himself as part of the conquest, or transferred by force from some neighboring cities to colonize the royal domain; but if one judges of them by the appearance of their proper names, there were also among them Germans and other barbarians, whose fathers came into Gaul as workmen or servants, with the conquering bands. Besides, whatever their origin or their kind of industry, those families were placed in the same rank and designated by the same name, by that of "lites" in the Teutonic tongue, or that of "fiscalins" in Latin, i.e., attached to the fisc. Buildings for farming and breeding, stables, sheepfolds and barns, hovels of laborers and huts of serfs of the domain, completed the royal village, that perfectly resembled the villages of ancient Germany, though on a larger scale."[1] Live hedges, walls of dry stones and ditches, surrounded the entire group of bu-

buildings, and formed several enclosures, according to the custom of the peoples of the North. The architecture of the buildings partook of the various influences under which they had been erected; it was a mixture of Gallo-Roman traditions and wooden structures built with a certain art, painted in br brilliant colors. Barns, sheds, enormous cellars, contained provisions accumulated during several months, and that the barbaric princes desired to consume wit: their vassals. When all were exhausted, they transferred into another domain. These palaces were erected on the borders of great forests, echoing with the cries of the hunters and the tumults of orgies, often prolonged for several days. The Carlovingians also retained that custom of living in country palaces, and Charlemagne possessed them in great number.[2] But then life in common was replaced by a sort of etiquette; the palace resembled more the court; beautiful gardens surrounded it, cultivated with care: the enclosures were more prominent. yet great hall or basilica always formed the principal part of the manor. Here (1) is a view of the entirety of a Carlovingian palace. Charlemagne caused to be entirely rebuilt the palace of Verberie near Compeigne. Numerous fragments of it still remained in the last (18 th) century, if one credits Father Carlier.[3] According to that author, Charlemagne had built the tower of the Proedium, i.e., the keep dominating the domain, a tower whose substructures were still visible in his time. He also caused the building of the principal building, "an immense edifice," as well as the chapel of the palace, which "still retained the name of chapel Charlemagne in the 14 th century."

Note 1.p.2. Recit des temps merovingiens, by Augustin Thierry. Recit 1.

Note 2.p.2. Charlemagne also had palaces in the cities, among others that at Aix-la-Chapelle, which passed as very beautiful. (Old French poem). (La Chanson des Saxons. Chap. 30).

Note 3.p.2. Hist. du duche de Valois, by Father Carlier, p prior of Andrezy. 1764. Vol. I. Book 2, p. 169.

"That palace," says Father Carlier, "had several dependances, that formed many separate castles, each of which had its purpose. The palace of Verberie had its outlook to the South; the edifices composing it extended from West to East on a line of 1536 ft. A very vast main building, in which were held general

assemblies, parliaments, councils, etc., the mallobergium,[1] terminated that series of buildings at the West, like the chapel at the East. The chapel and assembly hall thus formed two wings, that accompanied a long series of edifices of different forms and sizes. At the middle of that entire extent appeared a magnificent building of excessive height, composed of two great stories. I have taken these notes," adds Carlier, "from some remains of the ancient palace and from a document of the reign of Francis I, that permits the demolition of the different parts of the palace. Those portions of the buildings had been burned under the unfortunate reign of Charles VI earlier."

Note 1.p.3. Mallobergium, malbergium, house of pleas, where justice was done. (See Ducange, Glossaire).

It was only after the invasions of the Normans, that these residences were converted into fortresses, constituting the first feudal castles. (Art. Chateau).

The residence of the kings of France on the island of the Cite at Paris was designated by the name of palace in particular, while men spoke of the castle of the Louvre and castle of Vincennes. All sovereign lords possessed a palace in their domain. At Troyes was the palace of the counts of Champagne, at Poitiers that of the counts of Poitiers, at Dijon that of the dukes of Burgundy. Yet, dating from the 11 th century, and according to the habits of the lords of the middle ages, the palace was either fortified or surrounded by a fortified inclosure; but generally it occupied a more extensive area than the country castle, composed of more varied services, and leaving some dependances accessible to the public. It was the same for the urban residences of the bishops, that also took the name of palace, and that were not absolutely closed to the public like the feudal castles. Several of our old episcopal palaces in France thus retain servitudes, that date back several centuries. The courts, trials, parlements, tribunals of the officials, were held in the palace of the sovereign or bishop; it was then necessary to allow the public to attend these on many occasions. The essential part of the palace is always the great hall, a vast covered area, that served for holding plenary courts, in which vassals were convoked, banquets and festivals were given. Long galleries always accompan-

accompanied the great hall; they served as promenades. Then comes the chapel, sufficiently vast to contain a numerous a audience; then the apartments of the lord, lodgings of the courtiers, the treasury, the room for documents; then finally the barracks for the men at arms, kitchens, cellars, storerooms, prisons, stables, yards and nearly always the garden. A principal tower or keep crowned that collection of buildings; also arranged irregularly according to the needs.

Most of those palaces were not built at one spurt, but had been added gradually, according to the wealth or importance of the lord for whom the residence served.

The palace of the kings at Paris, in which those sovereigns held their court from the Capets until Charles V, thus presented at the beginning of the 14 th century a group of structures, the oldest dating fr.the epoch of S. Louis, and the last in the reign of Philip the Fair. Excavations recently made w within the enclosure of the palace of Paris have brought to l light some remainsof Gallo-Roman structures, notably at the side on Rue de la Barillerie; but in the entirety of the buildings there remains nothing visible, that may precede the reign of Louis IX. From Charles V the palace was exclusively devoted to the service of justice, and the kings no longer occupied it. That sovereign did some internal work there, as well as Louis XI; but Louis XII enlarged it by constructing the bu building intended for the chamber of accounts, and that occupied on place S. Chapelle the site now devoted to the mansion of the prefect of police. We give (Fig. 2) the plan of the palace of Paris in the ground story, as it existed at the beginning of the 16 th century.

Of the buildings of S. Louis, there has remained as still t today, only the S. Chapelle A, the structure B comprised between the two towers of the quay of Horloge, and the square t tower C, whose substructure even appeared to belong to a yet earlier epoch. The building B for the kitchens is a little la later than the reign of S. Louis. Perhaps the enclosure E with the gates F, that existed on Rue de la Barillerie, and that in the 14 th century still fronted on the ditch, were erected by Louis IX, as well as the keep G, called tower of Montgomery,[1] which remained until about the middle of the last (18 th) century.[2]

Note 1.p.5. It was not that tower in which Montgomery was imprisoned after the tourney, that was so fatal to Henry II.

Note 2.p.5. So state two very curious drawings representing the demolitions of the palace before the construction of the existing facade on the court of May. Those drawings belong to M. Lassus, and have been lithographed to form a part of a monograph of the palace, that has not been published.

Philip the Fair caused the erection of the galleries M, the great hall I, the porticos K and the building L, "very sumptuous and magnificent works." says Corrozet,[3] who saw them entire, "built under the direction of lord Enguerrand de Marigny, count de longueville and general of the finances, and see (adds the same author) what men were hitherto employed in such work rather than those famished men, who only desired to steal the money of the prince." Enguerrand de Marigny was however hung, as everyone knows, which takes something from the moral sense of the remark of the good Parisian Corrozet.

Note 3.p.5. Antiquities de Paris.

The buildings of the chamber of accounts, commenced by Louis XI and completed by Louis XII, was at M. At N was a postern with little towers, interesting remains of which we saw four years since. That postern and the enclosure O with the quay date from the 14 th century. As for the enclosure E′, its traces were visible in the private houses before the construction of the existing building of the correctional police, as proved by a plan made with the greatest care by M. Berty, and accompanied by very precious data.[1] At P was the chapel placed under the name of S. Michel, at R the bridge of the Chargers, and at S the bridge of the Millers or Great bridge. At T was the garden, the lattices of the king, separated from a little island (island of Vaches) by a brauch of the Seine. There was a building for heating. Of this vast assemblage of buildings and monuments, there remain today; the S. Chapelle, only deprived or its annex V in three stories, serving as sacristy and treasury of documents; the ground story of the great hall as given in our plan; a considerable portion of the porticos K; the interior of the building of the kitchens and of the hall R, as well as the four towers on the quay of the Horloge; the building L for its entire height. In the court X was planted the maypole. This assemblage of monuments, all of good archi-

architecture, presented at the centre of the city the most ch charming appearance. We have endeavored to give an idea of it in the cavalier view (Fig. 3), taken from the lower end of th the island.[1] Foreigners visiting the capital marvelled greatly at the beauty of the buildings of the palace, principally the effect of the court of May, that on entering by the gate opening on Rue de la Barilliere presented a group of structures placed in a most picturesque manner. The grand flight of steps, that entered the second story of the gallery of Enguerrand; that on the right ascending on the terrace, communicated with the great hall; the walls of this with its tracery windows; the great keep of Montgomery, whose roof appeared above the roofs of the great gallery, the S. Chapelle with its treasury, really formed a beautiful entirety, although not symmetrical. If one turned to the left toward the chapel of S. Michel, he discovered the elegant facade of the chamber of accounts with its graceful covered stairway, then the stairway of the S. C Chapelle built by Louis XII, and then the great keep left at the back of the court. On passing, along the chamber of accounts one entered the gardens of the palace, and saw developed the animated facade of the building, of which there yet remains today an entire portion. At each step appeared a new view, a surprise, and the variety of all these buildings contributed to increase their extent. It is very far from this palace to the cold structures, wearying by their monotony, to which we are accustomed since the grand century.

Note 1.p.6. See Hist. topog. et Archaeol. de l'anc. Paris, by MM A. Lenoir and A. Berty. (Plate X).

Note 1.p.7. See the great birdseye plan of Paris by Merien, and the tapestry of the city hall; Topog. de la Gaule by Merien; Book III of Cosm. univers., Sebastian Munster and Belle= Forest, 1665; Plan of Gomboust; the work of Israel Sylvestre; Topog. de la France, Impl. Lib.; the work of Perelle (views of bridge of change); hist. pitt. du palais de Justice, by S Sauvan & Schmitt, 1825; Itin. arch. de Paris, by baron de G Guilhermy.

In this palace Charles V received and lodged the emperor Charles IV, probably in the buildings that occupied the site later assigned to the chamber of accounts. "Then the king caused the emperor to be lifted in his chair, and borne up the

stairs to his chamber (the emperor was gouty), and then the king at one side led the king of the Romans with his left h hand, and thus he conveyed him into his chamber of Irish wood, that looked out on the gardens and toward the holy chapel, a and which he had richly clothed, and all the other chambers behind were left for the emperor and his son; and he was lodged in the chambers and attacs, that his father king John had built."[1]

Note 1.p.9. Livre des faits eet bonnes moeurs du sage roy Charles. Chap. 38. Christine de Pisan.

It is certain that these palaces, these grand feudal residences in the middle ages arose successively. According to a custom that we see still observed in the East, each prince a adds to the buildings that he finds standing, a building or hall, according to the taste or needs of the moment. There is no general project followed systematically and executed in p parts, and far from conforming to an uniform arrangement, the lords tha add some building to the residence of their predecessors, aim to give the new work a different character; thus they mark their passage, leaving the imprint of their epoch by building an entirely new lodging according to the taste of the time, rather than appropriate old structures. Those residences then present diversity, not only the parts composing t them, but also from each other, and if this programme be the same, the manner in which it has been interpreted differs in each province. Here a chapel assumes a considerable importance, there it is reduced to the proportions of an oratory. In one palace the keep is important as a defensive work; in another it only consists of a building a little larger and higher than the rest of the lodging. The grea. hall always occupies a vast area, for that is an essential part, a sign of feudal jurisdiction, the place for great assemblages; as in the castles, it possesses a broad flight of steps and rises over vaulted cellars. For example at Troyes, the palace of the counts of Champagne adjoining the church of S. Etienne, that served it as chapel, in comparison to the religious edifice, had but a quite moderate area; its lodgings were few, but the great hall was 170.6 ft. longby about 66 ft. wide. A square tower adjoined the north side of the church and depended on that, but served as treasury and keep. The rooms intended for habi-

habitation were contained in the second story over a vaulted ground story, and were placed in line at one side of the great hall and before the church on the west side; they looked out on the branch of the Seine. A garden at the south side of a court at the north side limited the palace; on that court extended a wide flight of steps serving as the principal entrance of the great hall.[2] Further, the palace of Troyes ceased to be the residence of the counts of Champagne after 1220; they preferred to establish their residence at Provins.

Note 2.p.9. See the plan of this palace in Voyage Archaeologique dans le departement de l'Aube, by A. F. Arnaud. (1837). This palace is entirely destroyed.

The palace of the counts of Poitiers is one of those in France, which have perhaps retained the most beautiful remains. Built on Roman ruins by the Carlovingians, then destroyed on several occasions, it was rebuilt by William the Great at the beginning of the 11 th century; of that structure nothing remains. To Guy-Geoffrey, son of William, is attributed the construction of the great hall, that we see today; but that hall presenting all the characteristics of the civil architecture of the end of the 12 th century, and Guy-Geoffrey being dead in 1086, it is necessary to find another founder for it. The palace of Poitiers was burned in 1346 by the English, then repaired in 1395 by John, duke of Beery and count of Poitou. That prince, brother of king Charles V, caused to be rebuilt the gable wall of the great hall, decorated by an immense fireplace (Art. cheminee, Figs. 9, 10), and the keep that still exists although much mutilated, and that serves today for the assize court.[1] That magnificent structure is composed of a g great rectangular building with three vaulted stories, flanked by four round towers at the angles, and is crowned by machicolations, battlements and roofs.

Note 1.p.10. M. Ch. de Cherge in his Guide du voyageur a P Poitiers says:- "There is found the historical tower of Maubergeon (mahlberg, audiences in covered places, mallobergium), the place where from the origin and under Charlemagne were held public audiences and justice was rendered, to which were since held all capital fiefs of the province. It was in the palace of Poitiers tha the dauphin of France was proclaimed king under the name of Charles VII (Oct. 1422); also there was inter-

interrogated by the most skilful doctors, Joan of Arc, the Maid (March, 1429); there were assembled the parlements of Paris a and of Bordeaux at the time when France was almost entirely English." If a monument is historical, it is indeed this.

We give (Fig. 4) the plan of the still existing parts of t the palace of Poitiers. At A is the great hall, at B the keep. Other buildings existed at C, but of them remain only some t traces. The wall of the Gallo-Roman city passed at R and served as substructure of the great hall, whose entrance was at D. A deviation of the public street or perhaps the orientation caused the placing of the keep askew, as indicated in the plan. This palace keep assumes a particular arrangement, which is not that observed in the keeps of castles, that present only one tower or group of lodgings strongly defended by important works, for example like that of the castle of Pierrefonds. T The keep of the palace of Poitiers is not itself a little castle, possessing a great hall in each story and chambers in the towers. It assumes the appearance of a fortress, but it is r really but a great residence, lighted by wide openings and nowise suited for defense; it approached civil architecture, and the towers and machicolations are there merely as a feudal d dress.[1] We give (5) an elevation of the keep of the palace of Poitiers, made of an end. Today these towers are removed to the level N; yet the 16 statues have been retained on their corbels, although much mutilated. Those statues are clothed in the civil costume of the beginning of the 15 th century. Did the artist wish to represent the counts of Poitou? That is difficult to know. However that may be, they are beautiful works. The cross section of the keep made on the line B C of the plan (Fig. 6) shows the two lower halls, with their vaults resting on a row of three piers, then the third story forming one great hall without piers. Above are found the attics and the defensive galleries serving the machicolations. A sc-screw stairs placed in the square tower, formerly enclosed in the structures built between this keep and the great hall, al allows one to reach the three stories by an oblique passage, as indicated by the plan.

Note 1.p.11. Indeed the projections of the ornaments surrounding the windows, the statues ornamenting the cylindrical towers, would have interfered much with the service of the machi-

machicolations, if one had desired to use them in case of attack. M de Merindol was indeed willing to communicate to us the excellent work, that he has done on the palace of Poitiers, and from his very accurate drawings have been reduced our illustrations.

The palaces of the lay sovereign lords form a sort of oppidum in the midst of the cities in which they are located, and a place both fortified and sacred like the acropolis of the G Greek cities. In the palaces of the sovereign were preserved the most precious relics and those most venerated by the people; there were deposited the charters and treasures; there were held planary courts, parlements sat and festivals occurred on the occasion of the marriage of princes and treaties. As for the palaces of bishops, they have a different character, t at merits the attention of archaeologists. Situated in the vicinity of cathedrals (which is natural), they are nearly a always built along the walls or even on the walls of the city, and can aid in their defense at need. This fact is too general not to have had a common origin. In the first place, it will prove this:- that the palaces of bishops were primitively placed on some fort belonging to the walls of Gallo-Roman cities; in the second place, that the construction of those palaces must have preceded the erection of the cathedrals and have d determined their location. Indeed one cannot explain why most of our oldest catnedrals, rebuilt several times on the same site always,since the 7 th and 8 th centuries, those of Paris, Meaux, Bourges, Amiens, Soissons, Beauvais, Laon, Senlis, Langres, Auxerre, Mans, Evreux, Narbonne, Alby, Angouleme, Poitiers, Carcassonne, Limoges,and so many others, rather stand n near the ancien ramparts, than at the middle of the enclosure of the cities. The Gallo-Roman cities possessed either a c capitol or at least a fort, beside one of the ramparts, as a are still our modern citadels; in the midst of that Gallo-Romau capitol or in one of those forts near the ramparts were placed the first palaces of the bishops. let us not forget to that at the end of the 6 th century, "the bishops were the n natural chiefs of the cities; that they governed the people in the interior of each city; that they represented them before the barbarians; that they were their magistrates inside, their protectors outside." [1]

Note 1.p.14. Guizot. Hist. de la civiliz. en France 8 th lesson.

The episcopal palace being eerected, a cathedral arose beside it, and each time that the cathedral was rebuilt anew, it was rare that the episcopal palace was not rebuilt at the same time. Now there remain to some plans of bishop's palaces of the 12 th and even the 11 th centuries. These plans present a nearly un-uniform arrangement; a great hall, a chapel, a tower or keep, various dependances between the palace and the cathedral, and lodgings that were probably of little importance, since no tr traces of them are found. The representative mark of the episcopal power, both religious and civil in the first centuries of the middle ages, is the great hall, a canonical and civil curia and at need a fortress, that later became the offices and the hall of the synod. The palace of the bishop of Paris, rebuilt by bishop Maurice de Sully about 1160, still retained this character; it otherwise merely replaced an earlier palace, whose foundations were discovered by us in 1845 and 1846, and could pass for a Gallo-Roman structure. That was the residence mentioned by Gregory of Tours, and which existed in h his time. In the episcopal palatine chapel, whose remains we still saw in 1830, was read this inscription, reported by P. du Breuil;[2] "This basilica (the chapel) was consecrated by lord Maurice, bishop of Paris, in honor of the blessed Maria, the blessed martyrs Dionysius, Vincent, Maurice and all the saints." Now that palace rebuilt by Maurice de Sully, consisted of a g great hall, with buildings attached to the choir of the cathedral, which was rebuilt at the same time, and the chapel. No traces of the private lodgings of the prelate. Here (Fig. 7) is the plan of that episcopal palace of the 12 th century.

Note 2.p.14. Theatre des antiquities de Paris. 1612.p.43.

At A was the chapel, at B the keep, and at C the great hall, which did not then extend beyond the gable wall D. The choir of the cathedral rebuilt by Maurice de Sully is at A, the hall F served as a treasury in the second story, with stairs of c communication between the palace and the choir, and as sacristy in the ground story. The great hall in the second story formed a single vaulted interiir. Here the Gallo-Roman wall of t the city passed at V under the cathedral and beyond its apse, and in excavating for foundations of the new sacristy, we f found a substructure of the same epoch at R and P. It would

then appear that the bishops of Paris profited by a projection formed by the defenses of the City, a sort of fort, to enclose therein the episcopal palace. The southern wall of the great hall was itself built on the foundations of the Gallo-Roman wall and was also crenelated by Maurice de Sully. "Then," says P. du Breuil, "the bishof and his people went from the great hall to the great church (the cathedral) by the gallery (the wing F), which the succeeding lord bishops Ponchers (of the 16 th century) sometimes left to the canons, who deposited there the relics and the most beautiful ornaments. After lord Pierre d'Orgemont (beginning of the 15 th century) caused the building of the second lodgings, that he placed as much on the garden as on the saed place (this is the building H). Long afterwards lord Etienne de Poncher (beginning of the 16 th century), 102 nd bishop of Paris, caused the erection of t the building adjoining the old one, which is opposite the church, where is now the jail and other habitations (this is the double building at K). Lord Francis de Poncher, his nephew and successor, caused the erection of the third lodgings, which is behind the chapel (this is the building L). In that place were previously the stables and some little houses in which dwelt the four canons of the lower chapel." The chapel in fact had two stories, like that of Meaux, and later that of Rheims. The structure O only dated from the 17 th century, and at R were the buildings ceded to the Hotel-Dieu. The double bridge S was built later, after all these structures. The bishops of Paris had only this palace with only a great hall for some c centuries. Hugnes de Besancon in 1326 had his mansion at Rue des Amondiers. William de Charac, his successor, lodged in Rue de Bievre, and gave his lodging for the foundation of the college of Charac or of S. Michel. Pierre d'Orgemont, who built the annex K to the great hall of the episcopal palace, inherited the mansion des Tournelles, that belonged to chancellor d'Orgemont, his father, and sold it to the duke of Berry, of whom he was chancellor. Girard de Montagne had a house in Rue des Marmosets and another in Rue S. Andre-des-Arts.[1] Along the river and behind the apse of the cathedral extended gardens, that adjoined the cloister of the chapter built at the n northeast. The great crenelated hall of the 12 th century, w with its annex erected by Pierre d'Orgemont at the beginning

of the 15 th century, its keep and its chapel in two stories, had a very grand appearance from the bank of the river, as s shown by the perspective (Fig. 3) taken from the point 7[2] before the additions O and the construction of the double bridge.

Note 1.p.12. Sauval. Book VII.

Note 2.p.12. See the tapestry of the city hall; the plan of Gomboust; the great birdseye plan of Paris by Merian; the views of Israel Sylvestre; those of Perelle, the plan of the i island by abbe Delagrive; the plans and sections deposited in the archives of the empire, and tracings of which M. A. Berty has had the courtesy to communicate to us; an engraving of t the place of Notre Dame by L. van Merlen, that shows hri upper part of the building H.

One of the oldest episcopal palaces, that of Angers, built toward the end of the 11 th century, still retains its great Romanesque hall in a beautiful style (Art. Salle), and very important dependances, that date from the same epoch. Recent works directed by the diocesan architect, M. Joly Leterme, have caused to reappear a part of the lodgings surrounding t that great hall,[2] which is placed in direct communication with the north transept of the cathedral. One even notes certain portions of walls of this palace, that have entirely the character of the Gallo-Roman construction of the late time, and that could indeed have belonged to them, as Dr. Cattois observed at the habitation, that the early mayor of the palace of Neustria, Rainfroy, had erected on the site of the capitol at Angers. At the bishop's palace of Meaux exists a chapel of two stories, of the second half of the 12 th century having the closest relation to that of the old bishop's palace of Paris, and the lower story of the great hall. This ground story, like that of the episcopal palace of Paris, consists of two vaulted aisles. The palace of Meaux is likewise b built in the vicinity of the Gallo-Roman ramparts. At Soissons the bishop's palace rests on a part of the ancient wall, but of the structure of the old palace there remains only a small tower of the beginning of the 13 th century and some substructures of the same epoch. At Beauvais the episcopal palace joins the ancient Roman fortification, and a little tower dating f from the 12 th century flanks even the old Roman wall.[1] At R Rheims the lower story of the great hall dates from the begin-

beginning of the 13 th century, and the two story chapel from the middle of the 13 th century. (Art. Chapelle). At Auxerre, one of the gable walls of the great hall still exists and dates from the middle of the 13 th century, like the choir of t that cathedral; a gallery of the 12 th century rests on the old wall of the Gallo-Roman city. At Rouen, one likewise finds very considerable remains of the 13 th century, and notably of one of the gable walls of the grea. hall. At Laon the group of buildings of the bishop'spalace (now palace of justice) is most interesting to study. This palace was rebuilt after a fire in 1112, which destroyed the old cathedral and the adjoining buildings. Indeed, one finds in the bishop's palace of Laon portions of structures belonging to the style of the first half of the 12 th century, notably the chapel A (Fig. 9) and the building B. As for the great hall C erected on a ground story and an added portico beside the cathedral, its construction is due to bishop Garnier (1245). The great hall is lighted from the court O and from the country. The internal p portico was rebuilt at an epoch already early. The arches were rebuilt, and the sills of the windows were lowered; the proof of this rebuilding is by observing the unique return arch E, whose curvature and primitive ornamentation ahe preserved. The appearance of this great structure on the exterior must have been very beautiful before the mutilations that altered its character. This facade which dominates the wall of the city passing parallel at some yards from its base, is flanked by three turrets borne on buttresses, and between which open the windows of the great hall in the second story. The cornice was formerly crenelated, and could at need serve as a second defense above the rampart of the city, dominating a steep precipice. Here (Fig. 10) is a view of that external facade t taken from the point P. In the 15 th century the bishops of Laon (see plan, Fig. 9) erected the two structures F and G. A fortified gate was opened at K.

Note 3.p.16. See in Vol. II of Arch. civ. et dom. of Verdier & Cattois, p. 201, the plan of the episcopal palace.

Note 1.p.18. That little tower still exists. (See Arch. civ. et dom. of Verdier & Cattois. Vol. I.

The portico occupying half the length of the great hall of the court side gives to the episcopal palace a particular ap-

appearance. That gallery is exposed to the south on a plateau whose temperature is usually cold, serves as a promenade, and contributes to the comfort of the habitation. The episcopal palace of Laon, like those we have described above, was no less a fortified place very well located, easy to guard and defend. We see that the archiepiscopal palace of Narbonne in L Languedoc, although rebuilt at the end of the 13 th and during the 14 th centuries, is still an actual strong place probably erected on the site of the capitol of the Roman city. After the palace of the Popes, this is the most important structure in France, that remains to us from the numerous residences o occupied by the princes of the Church.

The archiepiscopal palace of Narbonne is connected to the existing cathedral, founded in 1272, by a cloister built by archbishop Pierre de la Jugee in the second half of the 14 th century. Already in 1203 the great square tower of the palace, serving as keep, had been built by archbishop Gilles. Pierre de la Jugee erected between the cloister and that tower extensive buildings that still exist in great part, and that comprise several round towers, lodgings, a great hall and another square tower forming a pendant to the keep. Still, in the midst of these structures of the middle ages one yet finds a very old Romanesque tower, and a beautiful doorway of the beginning of the 12 th century.

It is true that the archbishops of Narbonne were powerful lords during a part of the middle ages, and their palace after the 11 th century acquired an importance corresponding to their fortune. In 1096 archbishop Dalmatius assumed the title of primate of Gaul. The city of Narbonne further had retained in part its Roman municipal administration, like many cities of the South.

Until the 12 th century, the commune possessed councillors who took the title of noble or upright men. Then they were termed consuls, or rather "cossouls." That commune in 1166 made a commercial treaty with the republic of Genoa, and later with Pisa, Marseilles, [illegible], etc. In 1212 Armond Amalric, legate of the Pope and archbishop of Narbonne, declared himself duke, and the viscount rendered homage to him. Then the city was a under the jurisdiction of three lords, the archbishop, the v viscount and the abbot of S. Paul; in 1232 these three person-

personages confirmed the franchises and customs of the commune. Yet in 1234 the consuls of Narbonne invoked the aid of the c consuls of Nimes against the archbishop, and in 1255 the municipal magistrates ordered that the customs of the city be translated from Latin into Romance, so as to put them within reach of all. The viscounts were less powerful than the archbishops, and were inclined to protect the prerogatives of the Narbonnese, and the presence of that increasing strife against the peace of the lord archbishops, Gilles Ascelin erected in 1318 an enormous tower still intact today, and that his successors made their residence, an actual strong castle, connected to the cathedral and itself fortified.[1]

Note 1.p.21. We owe these historical statements to M. Tournal, conservator of the museum of Narbonne.

This mixture of architecture, militany, religious and civil, thus made of the episcopal palace of Narbonne an edifice most interesting to know. Let us first say that it is unnecessary to seek there the influences of the Italian art of the 14 th century; that edifice is indeed French, and rather southern French that that of Languedoc. Its roofs were steep, as proved by several existing gables; the construction of the vaults, sections of piers, the cloister and its details, the form of the windows, the defensive positions, and even the masonry, belong to the architecture of the royal domain; the archiepiscopal palace of Narbonne is the more curious for study, in that it must have served as a point of departure for constructing the palace of the Popes at Avignon, with which we shall soon occupy ourselves.

Here (Fig. 11) is the plan of the palace of the archbishops of Narbonne in the ground story. At A is the cathedral, begun in 1272 as we have stated, on the French plan. (Art. Cathedrale, Fig. 43). An ancient strong place [2] is at B, that very probably occupies the site of the forum of the Roman city. T The foundations of the antique capitol determined the arrangement of the buildings, that pass around it from the angle C t to the cathedral. At D is a Roman tower, and at E are buildings, some parts of which belong to the 12 th century. The great square tower built by Gilles Ascelin in 1318 is at F. It is placed on the square opposite the much lower tower of the viscount, consequently it dominates the tower of the lay lord

and the canal that connects it with the part, that passes at about 33 ft. from the point C. From the place B to the cloister G the ground rises about 16.4 ft. One enters the court H of the palace, passing under an arch I and taking a street bordered by fortified buildings, and through the great vaulted porch E. At O was the hall of the guards, communicating in the ground story with the tower called S. Martial at U by internal steps. By passing along the street K and under a fortified arch, one reaches the flight of steps Q, that ascends to the cloister, which communicates with the cathedral by a doorway R.

Note 2.p.21. Now called Place aux Herbes.

From the court H by descending the steps S terminating in the uncovered area S″, and taking at the left a tunnel passing under the great building V, one reached a postern T opening into a ditch, that separated the entire front from a garden, forming an advanced work. The great structure V was occupied in the ground story by cellars arranged under the great hall. From the court H one ascended to the apartments by a s stairway X, now destroyed.[1] At d and d′ were porticos, and at Z a receding structure that connected the great tower to the tower S. Martial.

Note 1.p.22. This stairway was destroyed about 1620, and re replaced by a beautiful stairway placed in the tower Y. From 1820 to 1834 were erected new facades in the court, and grand apartments were arranged, now partly occupied by the museum of the city. We have found traces of the foundations of the stairs X.

The last portion, of which we saw only fragments before 1347, included in far more recent habitations, was razed to give place to the new building of the city hall. But having b been charged to direct that last structure, we have been able to determine the arrangement of the great buttresses M with machicolations, and of the little guard room N with its postern n. The buildings p are called the Madeleine and are the oldest. They consist of a vaulted story and a great hall t, also vaulted, beneath a beautiful chapel arranged in the second story; this hall t communicates with the passage called Ancre [1] by two doors V V′. Those doors V V′ must permit the public to enter the hall t, which served as the lower chapel. Those doors V V′ must permit the public to enter the hall t,

which served as the lower chapel. A common court was arranged at a with a small fortified building e. The wall of the palace of the archbishop joined that of the cathedral by a wall f, also fortified. At g is a great chapter hall. The apse of the cathedral continued the defenses at that side f by a series of little crenelated towers connected by arches surmounted by battelemnts, like the crowning of the chapel. This palace then presented an entirety of formidable dimensions dominated by the enormous square tower F forming a projection.

Note 1.p.23. This passage was so designated, because beneath the arch was suspended an anchor as a sign of the rights that the archbishops possessed over the port of Narbonne.

Let us now examine the plan of the second story of this palace (Fig. 12). The stairway X allowed one to pass directly from the court of the great hall V, possessing a vast fireplace, traces of which are still seen on the exterior. That great hall was lighted by high windows terminating in pointed a arches and covered by round arches, supporting fllor beams ab-above which was a ceiled story opening on the external battlements. From the great hall one could reach all the apartments. Screw stairs allowed a descent to the ground story at several places, or ascent to the upper stories. One sees that he could enter the octagonal hall of the square tower only by a bent p passage, and from that octagonal room he descended by a trap door into the circular room of the ground story, which served for a prison. Large machicolations opening on the third story at the height of the battlements defended the front a b. Here was recognized the utility of the passages arranged at T and P, on the two arches crossing over the street K; they established communication between the building L and that of the Madeleine at T, with the tower U of S. Martial and the chapel V. The cl cloister was covered by a terrace and afforded a promenade, f from which one could enjoy a singularly picturesque view of a all these buildings, one behind the other, surmounted at one side by the great square tower, on the other by the colossal apse of the cathedral.

These structures are built of beautiful stone from S. Jean and from Beziers; they cover an area of about 40,357 sq. ft. after deduction of the courts,and in spite of the numerous mutilations they have suffered, although modern flat roofs an

without character have replaced the old steep roofs, and although miserable additions or neglect has destroyed several of the most interesting parts, yet they do not fail to the imposing by their grandeur and their power.

We give (Fig. 13) a cavalier view of this palace, taken from a side of the great square tower. (Arts. Cloitre, Salle, Tour). But this palace of the archbishops of Narbonne, if compared to the palace of the Popes at Avignon is but a poor lodging. It is necessary to give a historical summary of their sojourn in county Venassin, in order to cause to be understood the importance of this residence of the sovereign pontiffs.

In the 13 th century the rock of Avignon, on which was to rise the palace of the Popes was partly pasture, partly covered by habitations dominated by the old castle or palace of t the podesta, not far from which rose that of the bishop.[1] Of these structures preceding the sojourn of the pontiffs, the church of Notre Dame des Doms served as cathedral and alone exists today.

Note 1.p.25. Latin note.

Pope Clement V came to Avignon in 1308 and resided in the monastery of the preaching friars (Dominicans). Clement V was Bertrand de Grotte, archbishop of Bordeaux; this prelate passed as the enemy of the king of France, Philip the Fair. That prince had an interview with him:- "Archbishop," said he to h him, "I can make you Pope if I wish, provided that you promise to grant me six requests, that I shall make to you." Bertrand fell on his knees and replied to him:- "Monseignor, now i see that you love mo more than any living man, and that you desire to render me good for evil. Command and I will obey." Bertrand de Grotte was elected and came to establish himself at Avignon in France.

John XXII dwelt in the palace, then situated on the site of the existing palace of the Popes (1316).

Armond de Via, his nephew and bishop of Avignon, had no palace, purchased the land on which was built the palace of the archbishop, today occupied by a little seminary. John XXII d desiring to enlarge the palace occupied by him, caused to be demolished the parish church of S. Etienne, which he transferred to the chapel S. Madeleine.

Benedict XII in 1336 caused the demolition of the entire

palace, that his predecessor had caused to be erected, and af after the plans of the architect Pierre Obreri,[1] caused the building of the northern portion of the apostolic palace, thhe terminated by the tower of Trouillas. Under that pontiff, the apostolical chamber purchased the palace, that Armond de Via had built to serve as a residence for the bishops of Avignon. Clement VI caused the erection of the southern facade of the palace of the Popes, and the southern enclosures, which essentially served to contain the arsenal.

Note 1.p.26. Or Pierre Obrier, according to Annales d'Avignon, Vol. III.-- Manuscripts given to the museum of Avignon by M. Achard, architect of the prefecture.

Only in 1347 the city of Avignon and the county of Venaissin became the property of the Popes. Avignon belonged to Jane of Naples, who was countess of Provence at the same time as queen of the two Sicilies. Driven from Naples as suspected of complicity with the assassins of her husband, Andrew of Hungary, Jane sought refuge in Provence, and came to cast herself at the feet of Clement VI. When she left Avignon to return to her Italian states, she was declared innocent of the crime of which the public voice accused her; she was furnished with a dispensation to marry her cousin, Louis of Tarentum, the principal instigator of the assassination of Andrew. Avignon and the county of Venaissin belonged to the Pope. This cession h had been stipulated for the price of 80,000 crowns.

Innocent VI completed the southern part of the great upper chapel. Urban V caused the cutting in the rock of the site of the principal court of the palace, and excavated a well there; he caused the construction of the eastern wing looking on the gardens, and added a seventh tower, called of the angels, to the six previously built.

Gregory XI departed for Rome in 1376 and died in 1378. Thus the palace of Avignon had been the seat of the papacy from 1316 to 1376, 60 years under 6 Popes. The papacy was then French, chiefly elected among Gascon and Limousin prelates. The French installed candidates of their choice in the bosom of t the sacred college, and maintained their predominance during the sojourn of the Popes at Avignon. This fact should not be forgotten, since as we shall soon see, it had an influence on the construction of the palace of the Popes at Avignon.

The antipopes, Clement VII and Benedict XIII, occupied the palace of Avignon from 1379 to 1403 (March).

Benedict XIII was besieged in the palace by marshal Boucicaut on Sept. 8, 1398; The siege was converted into a blockade until after the departure of that pontiff in 1403. Roderic de Luna, nephew of Benedict XIII, was besieged anew or rather b blockaded by the legates of the Pope of Rome and by Charles of Poitiers, sent by the king of France in 1409. He evacuated the palace as well as the castle of Oppede by a capitulation dated Nov. 22, 1411.

The cardinal legate (cardinal of Clermont) caused to be built in 1513 the apartment called la Miranda looking south, a and the covered gallery that connected those apartments with the towers looking on the garden; there the vice legates received their visitors.

In the palace of Avignon were held six conclaves.

That for the election of Benedict XII in 1335; Clement VI in 1342; Innocent VI in 1352; Urban V in 1362; Gregory XI in 1370; Benedict XIII in 1394.

As a result of the conflict that occurred between the men of the Pope and those of duke de Crequy, ambassador of Louis XIV at the Holy See, the satisfaction demanded at the court of R Rome appearing insufficient, the king of France caused Avignon to be occupied by his troops, and he threatened the sovereign pontiff, that he would send a regiment to Rome (1662). General Bonaparte by the treaty of Tolentino obtained the cession of Romagna and of the county of Avignon.

Thus in 60 years the Popes not only caused the erection of that residence, but even the entire walls of the city, whose extent is 15,718 ft., or about 3 miles.

In 1373 a fire destroyed nearly all the roofs of the palace of the Popes.[1] In 1413, the great hall of the consistory, the quarter of the kitchens and that of the buttery were consumed, in spite of the diligence of Mark, nephew of Pope John XXII, who commanded then in that city.[1]

Note 1.p.27. Traces of that disaster are still to be seen in the upper parts of the edifice. "In the year 1378 at the hour of the death of Pope Gregory at Rome, according to the o old documents of Provence, the palace of Avignon was seized by that fury, that was never in the power of men, whatever

aid come from all parts, to extinguish or arrest, so that the greater part of that grand and superb edifice was devoured by the flames, as I have myself seen the marks and vestiges in that fiery and lofty mass of stones." Nostradamus. Hist. de Provence. p. 437.

Note 1.p.28. Journal d'un habitant d'Avignon, cited by Goufridi. Hist. de Provence.

The extended documents that M. Achard, architect of the prefecture of Vaucluse, has kindly gathered for us with a readiness for which we cannot sufficiently thank him, give only t the name of the architect of that colossal colonnade; it was a certain Pierre Obreri or Obrier. Obreri is scarcely an Italian name, but what is still so is the monument itself. The It Italian architecture of the 14 th century, whether taken in the south or the north of the peninsula, recalls nothing of t that of the palace of the Popes. From the tower of Trouillas to that of the Angels, in the entire extent of these buildings from north to south and east to west, the construction, mouldings, sections of piers, vaults, openings of defenses, belong to the French architecture of the south, to that Gothic architecture which wit difficulty disengages itself from certain Romanesque traditions. The ornamentation is further very sober and recalls that of the cathedral of Narbonne in its upper parts, which date from the beginning of the 14 th century. Now the cathedral of Narbonne is the work of a French architect, perhaps the same that built that of Clermont in A Auvergne and that of Limoges, as one might suppose from the p perfect conformity of these three plans. The sole details of the palace of Avignon, which are evidently of Italian origin are the paintings attributed to Giotto and to Simon Memme or his pupils.[2] Let us further not forget, that Clement V, that established the apostolic seat at Avignon, was Bertrand de G Grotte, born at Villandun near Bordeaux; that John XXII, his successor, was Jacques d'Euse, born at Cahors; that Benedict XII was Jacques Fournier, born at Saverdun in the county of Foix; that Clement VI was Pierre Roger, born at the castle of Maumont in the diocese of Limoges; that Innocent VI was Etienne d'Albert, born near Pompadour in the diocese of Limoges; that Urban V was William Grimoald, born at Grisac in Gevaudan, diocese of Mende, and that Gregory XI, nephew of Pope Clement

Vi, like his uncle, was born at Maumont in the diocese od Limoges. That these Popes, who admitted in the sacred college a great number of French prelates, and particularly Gascons and Limousins, would have called Italian architects to build their palace is scarcely probable; but if they had invited them, that it would however be impossible not to regard the structures of the palace of the Popes at Avignon as belonging to the architecture of the southern provinces of France. We insist on that point, because it is a prejudice commonly established, that the palace of the Popes is one of the grandiose structures belonging to the arts of Italy, and it is neither by grandeur nor by freedom, that it is distinguished. The Popes established in France, possessors of a rich county, collecting considerable resources, living comparatively in a state of pr profound peace, all being from these dioceses of the South, then so rich in monuments , have built at Avignon a work absolutely French, much superior in general conception, grandeur and taste to what was then erected in Italy. Let us now examine this vast edifice in all its parts. We shall take the palace of the Popes at Avignon as it existed at the end of the 14 th century, i.e., after the successive restorations made from Clement V to Gregory XI, for it would be difficult to gi give the transformations of the various services composing it, and to show, for example, the palace built by John XXII. These immense structures rise on the southern slope of the rock of Doms and opposite the Rhone; so that the ground story of the adjoining part of the Church of Notre Dame, which is the oldest, finds itself on the level of the second story of the part of the buildings last erected on the south side by Urban V. If we then trace the plan of the ground floor of the palace of the Popes at its lowest part, we shall come into the solid rock by advancing to the North. (Fig. 14).

The entrance of honor A opens on an open space dominating the surroundings, formerly divided in several courts with curtains, tower and gates. That entrance A is defended by two p portcullises, door leaves and a double machicolation. Before it and opening on the area, the advanced work was replaced in the 17 th century by a wall for counter-guard with battlements. Beneath the entrance vestibule at the right is the doorway o opening into a great vaulted guardroom. From the court of honor

C one can go to all parts of the palace. From the vestibule D he ascends to the upper story by a broad and beautiful stairway in two flights, where indeed he enters the great lower hall E and its annex F, or also the hall G. By the passage H he descends to the eastern esplanade I, from which he enters the halls K beneath the great tower L and its annex l. By the little bent passage O he enters the great hall M, which serves as a post and communicates with the upper defenses by a s stairs P. At R is a postern defended by inside machicolations, a portcullis and folding doors; at S is a second postern defended by machicolations and a portcullis; at T a flight of st steps ascends to the ground story of the part of the palace built on the rock at a level above the ground of the court of honor. The oldest portion of the palace, the tower of Trouillas is at V, flanking the rock, and rising above all the other towers of the palace; this is the keep, of which we see here only the substructure. A stairs X serves this part of the buildings and descends to the ground of the esplanadeI, giving e entrance on the wall of defense Z furnished with machicolations and a defensive gallery. At N and set against this wall is a bakehouse.

All this ground story is vaulted and built in a manner to defy time and the hand of man. From the guardroom B one ascends by a screw stairs to the upper defenses of the principal gate A. Another stairs Q ascends to the apartments looking over the esplanade.

As one can recognize, the arrangement of the ground story is good, because from the court of honor one directly reaches all parts of the palace. Let us also note tha the two posterns R and S are pierced in reentrant angles, well masked and defended; that the fronts are flanked, and that the architects have profited by the natural arrangement of the rock to e establish their structures. Gardens extend on the southern side on a sort of projection forming a hill. At one side (toward the North) the rock of Doms is vertical on the Rhone, and it was further defended by a fort (S. Martin). At the other (toward the south) it is planted in the middle of the city, and thus divides it into two parts. Toward the west, the courts extend to the episcopal palace, and were stopped by the rampart of the city, which descended to the bank of the Rhone and

joined fort S. Martin.[1] Flights of steps arranged beside that fort descended to the gate of the little cloister giving entrance to the bridge S. Benezet, that crosses the Rhone (Art. Pont). On the east the precipice is abrupt and dominates the streets of the city. The site of this palace was then wonderfully selected to hold the city in dependance or under protection, to watch over the banks of the river jus at the point where it forms quite an abrupt bend, to be in communication with the enclosing wall, and at need to leave that city without being seen.

Note 1.p.31. This fort was destroyed in 1650 by the explosion of the powder magazine contained in it.

To multiply illustrations, we present the plan of the palace of the Popes in the ground story for the highest portion, and on the second story for the buildings situated above the buildings enclosing the court of honor. In fact the level of the ground story of the upper buildings corresponds to the level of the mezzanine story partly arranged on the plan given in Fig. 14.

At A (Fig. 15) is the church Notre Dame des Doms, rebuilt in its original form and before the addition of the chapels, that changed the plan of that beautiful edifice. Erected during the 12 th century, the church Notre Dame des Doms, today still the cathedral of Avignon, was retained by the Popes, a and in its vicinity the pontiffs erected the first structures of their palace, among others the towers B and the hall b. A Advancing gradually toward the south, and following the slope of the rock, the Popes at first closed the court C, surrounded by a wide portico with a story above it, and then the court of honor D. It is to be noted that in erecting each tower and each structure, they were fortified, so as always to protect from attack the completed portions of the palace. Thus for example, the building E was defended by machicolations at e, b because at the time of its construction it had a direct view outside, the court of honor D and the great hall G having been built last, as well as the tower H.

Under Urban V the apartments of the Pope were in the second story around the court of honor. A great hall (the hall G) was entirely vaulted and served as a chapel. Its vaults were covered by beautiful paintings, of which there remain only frag-

fragments. The stairway of honor I gave admission to that chapel and to the apartments of the lodgings at west and east. A service corridor extended beside the rooms in the western wing, reached by the stairs K, communicating with the porter's lodge and the upper defenses by the screw stairs L, ending over the postern P, and placing the western wing in communication with the lodgings E. Battlements with wide machicolations bordered the chambers of the western wing outside, at the level of the second story. At F were placed in the second story the great kitchens II.[1] The festal hall was over the hall b, and was separated from the galleries of the cloister by a very narrow a and very long court; one will note that machicolations defended the foot of the four buildings around that cloister. Partitions are not inserted in the plan because they have been changed several times in locations, divided the lodgings surrounding the cloister and left service corridors. This vast p palace was then very habitable, all rooms being lighted, at least on one side. One will also note that in the thickness of the walls in particular are constructed service passages and stairs that connect the diffeent stories, and that can aid the defense if necessary. An elevation made of the entire extent of the western facade will exhibit the entirety of this majestic palace (Fig. 16), that dominates the city of Avignon, the course of the Rhone and the surrounding country. It was formerly richly decorated by paintings in the interior.[2] But two fires, abandonment and vandalism have destroyed the greater part of the decorations. Some quite richly painted ceilings date from the 16 th century. The steps of the grand stairway, now dilapidated and mean, were made of marble or p polished stone, and its vaults were painted. The chapel was most splendid and contained precious monuments; in this nave were deposited the trophies sent to the Pope in 1340 by the king of Castile, after the victory of Tarifa.

Note 1.p.33. Those are the kitchens, which are now shown as being a hall of execution with closed doors and a chamber of torture.

Note 2.p.33. There remain of those paintings only traces in the great chapel, and in two rooms of the tower now called t that of Justice.

The two turrets that surmount the entrance gate in the form

were only destroyed in 1749, because they threatened ruin (according to a report of lord Thibaut, engineer, dated March 29 of that year); a painting deposited in the library of Avignon and several engravings have preserved their forms for us. As for the tops of the towers, particularly that of the tower of Trouillas, they were only completely destroyed at the beginning of this (19 th) century, and are likewise reproduced in pa paintings and engravings of the 17 th century. The palace of the Popes possesses seven towers that are:- 1, the tower of Trouillas; 2, of Gache;[1] 3, of S. Jean; 4, of S. Laurent; 5, of the Bell; 6, of the Angels; 7, of the Estrapade.

Note 1.p.35. This name comes from the fact that it served as a watch tower (guette). From the top of the tower of Gache (nearest the facade of Notre Dame des Doms and the highest, see the facade), was given by the sound of trumpet the signal of the curfew, and the inhabitants were warned in case of fire or alarm.

The legates occupied the palace of Avignon after the departure of the antipope Benedict XIII, and they caused considerable works there, among others cardinal d'Armagnac in 1569; b but that vast residence was very dilapidated and "very bad to occupy," as Ch. de Brosses stated in the last (18 th) century. Today it is with great difficulty that one can recognize the internal arrangement through the floors and partitions that intersect the stories, to lodge the multitude.[3]

Note 2.p.35. This is the tower situated between the gate and the great chapel. See facade.

Note 3.p.35. The emperor Napoleon III ordered during his j journey to Avignon in 1860, the building of a barrack in the city, in order to clear and repair this magnificent palace.

The last example shows like the preceding, that the question of symmetry was not raised, when it was necessary to build the palace during the middle ages. Men sought to place the s services according to the site or the most favorable orientation, according to the requirements, and gave to each building the form and appearance suited to its purpose.

All episcopal palaces in France did not have that fortress appearance. The archeipiscopal palace of Rouen, the episcopal palace of Evreux and that of Beauvais, almost entirely rebuilt in the 15 th century, greatly resemble those princely mansions

opening externally by broad windows, and no longer possessing towers for defense. As for the kings of France, from the end of the 14 th century, when they resided in cities they occupied mansions. The king possessed several mansions at Paris, and in most cities was the king's lodgings, which often was v a very modest residence. Castles were preferred, for one enjoyed greater freedom there. The troubles that filled a great part of the 15 th century induced the sovereigns to no longer trust themselves excepting to good walls at a distance from the city.

The castles of the Louvre, the Bastile, and of Vincennes, those on the banks of the Loire, became the habitual residences of the kings of France from the wars of independence until the reign of Francis I. The great vassals followed in that the examples of the sovereigns, and preferred their castles to their urban residences, and the name of palace remained for the buildings occupied by the parlements.

PALIER. Landing of Stairs.

A rest arranged between the flights of a stairway. (Art. Escalier.

PALISSADE. Palisade. Barrier.

An enclosure composed of piles driven into the ground and sharpened at their upper ends.

Many market-towns, villages and rural habitations, manors, barns, etc., during the middle ages were only enclosed by palisades . The dependances of castles, lower courts, gardens, and warrens, frequently had no defense that a palisade with a live hedge. (Old French poem). [1, 2]

Note 1.p.38. Romans d'Alixandre; Combat de Perdiccas et d' Akin. Edit. of Stuttgart. 1848. p.140.

Note 2.p.38. The same; message a Darius. p.254.

It was also customary to plant palisades at the foot of the ramparts of cities, so as to leave between the wall of the en - enclosure of piles a space serving as a defensive passage or lists, as were then termed such spaces. That was one means for preventing assailants from sapping the foot of the ramparts, when there were no ditches, to prolong the defense, and to allow the besieged to make sorties. When an army invested

a castle or fortified city, at first furious combats occurred to get possession of the palisades and the lists, so that the miners might reach the walls, or bring up their cats, and rolling towers. (Old French poem). [3, 4, 5.]

Note 3.p.38. Roman de Rou. Verse 2800.

Note 4.p.38. The same. Verse 2828.

Note 5.p.38. The same. Verse 7352.

Those wooden structures around places often had great importance; they formed actual barbicans, or defended long covered lodgements. The besieged did their best to preserve them, for these palisades forced the assailants to extend their lines, permitted the entrance of aid and provisions, and rendered th the defense of the tops of the ramparts more efficient, because it swept a more extended field. (Arts. Architecture Militaire, Siege).

PAN DE BOIS. Half Timber Work.

A carpentry work composed of sills and plat s, posts, braces and ties, forming actual wooden walls, either on the fronts of buildings or in the interiors, and then serving as partitions. Today in France it is forbidden to place half timber work on the public street, in great cities, in order to prevent the communication of fire from one side of the street to the other. For the same reason it is not permitted to build party walls of half timber work. But until the last (13 th) century, the use of half timber work was very common, particularly in the cities of the North. Article Maison mentions a certain n number of habitations with front walls entirely or partly of half timber work very happily combined. This means had the a advantage of allowing superposition of corbelled stories, in order to leave a sufficiently wide passage on the public street and to gain area in the upper stories. It was economical and sanitary, for with equal thickness, a half timber wall b better protected the occupants of a house from variations of external temperature than a wall of brick or stone. There is no construction more stable, durable and lighter. Thus men s still habitually use half timber work in the interiors and courts, but instead of leaving it visible, as always practised during the middle ages, it is covered by plastering, that scarcely fails to heat the timbers and to cause them to decay;

but one simulates thus a construction of stone or at least of rubble plastered.

One cannot give the name of half timber work to squared trunks of trees piled horizontally; that sort of construction d does not belong to the art of the carpenter; it is seen used only by certain peoples, and it was never adopted on the territory of France after the Gallo-Roman epoch. According to Ce-aesar, the Gauls erected some structures, notably defensive walls, by means of logs alternating with stones and cross logs; but it does not appear that this method was employed during the middle ages, and it has no relation to what we call half timber work.

Half timber work by its combinations indeed requires an already extended knowledge of the art of the carpenter, and is found only among peoples that have long practised that difficult art. The Romans were skilful carpenters and kneu how in bried time to erect wooden structures of great importance. E Employing short timbers as more convenient, they framed them together solidly, and they could at need raise them to great heights.[1] The peoples of the North, and especially the Normans, were excellent carpenters, added new elements to those a antique traditions, as for example the use of timbers of great length and curved timbers, so frequently employed in naval carpentry; they adopted certain connections with joints of e extraordinary strength, as for resisting the shocks and concussions to which ships are subjected, and they never had recourse to iron to connect their wooden structures.

Note 1.p.38. Italian carpenters, notably at Rome, have retained the antique traditions, and they erect today in a few h hours scaffolds by means of short timbers of small dimensions. It is impossible to not recognize a perfect identity of means in these scaffolds and the carpentry represented on the reliefs of Trajan's column.

Lavish with a material not rare on the soil of Gaul, Romanesque architects, when they erected half timber work, left small space for the fillings, and freely used timbers at least very wide, if not very thick, cut from enormous trees, forming by their combination a heavy framework, scarcely leaving any spaces between them, except the openings necessary to light the interior.

Connecting by strongly pinned halving was one of those most frequently employed in those remote epochs. Thus were composed actual rigid panels, that entered into grooves in the sills and plates. Rarely in that epoch were corner posts placed at the angles, and the half timber work was set between the two end piers of masonry walls, that formed gable walls at the sides; in brief, the front half timber work of a house wa was only a front enhanced by bright colors outlined by wide black lines. It is well understood, that those structures preceding the 13 th century have long since disappeared, and scarcely in some old French cities were found any remains thirty years since; yet it is necessary to seek them under recent lathing, or to collect them during demolitions. Thus in 1834 at Dreux we could draw, while being torn down, the fragments of a house, that appeared to date at the middle of the 12 th century. The house was raised in the 15 th century, but only seems to have been composed originally of a great story, and a corbelled second story, with a garret. The old roof with an eave on the street no longer existed, and the garret story had been surmounted by a high wooden gable roof covered by w wooden tiles. Of the old windows there remained only the lintels with internal gains indicating the passage of halved jambs.

Here (Fig. 1) is a view of this curious half timber work comprised between two walls forming corbelled ends. The sills, plates and posts were timbers about 7.5 ins. square, the jambs of the windows were 5.9 × 7.0 ins. The arch of the door was composed of two great timbers halved together and with the two jambs. The joists of the floors, like the sills of the half timber work, rested on the side walls and on a beam placed p parallel to those walls about the middle of the facade. All that carpentry was framed with care, ornamented by some very simple mouldings and incisions of small depth. There were seen under the window sills of the attic remains of thick panels also ornamented by incisions. Fig. 2 presents the section of that half timber frame, and indicates the intermediate post A, reinforcing the front of the ground story and bearing by means of a strut B the transverse beam C, that relieves as much the span of the sill D of the upper half timber frame. Above this strut B is set the post E extending up to the plate F, supporting another transverse beam G under the roof. The end of that

beam is relieved by a strut I. A plate H receives the ends of the rafters and the blocks K. The girder L is tenoned into t the post E, which under that joint has a shoulder M (see detail O). This girder is further supported by a strut P, whose foot is tenoned into the first joist R of the floor of the se- second story. The view (Fig. 1) shows how the fronts of the half timber frame transfer the loads to the intermediate post and the side walls by means of curved struts, which join beneath the sills and at the ends of the hollowed window lintels. Fig. 3 well explains the joints of the little posts forming the jambs of the windows and of the curved struts. We show o one of these windows on the inside. The intermediate little posts B form mullions, are halved into these lintels, and bear at their upper ends a tenon that enters a mortise cut under the sill. A little tongue also enters into the lintel and keeps that flust with the post. The lintels A themselves have tongues f that enter under the sill at g. The sketch C gives an elevation of these connections, the inside of the half timber frame being at h. The little post G forming the jamb is likewise halved into the end of the lintel, and bears its tenon i dropping into a mortise j; but the strut E has a skew c cut l, that abuts the lintel, and a tenon m that enters the mortise n. This tenon also has a tongue entering the end of the lintel at P.

The connections of this carpentry recall those employed in joinery, and also those adopted for naval construction. The labor is considerable, as in all primitive structures; but one will observe that ironwork is not admitted anywhere. Besides the volume of the timber is enormous with regard to the small dimensions of this half timber front; the fillings in masonry or mud are almost nothing. Already in the 13 th century were erected half timber frames much lighter and better c combined, in which the labor was economized, and that presented perfect stability. Frequently at that epoch the floor beams rest on the half timber front, and serve to connect it with the internal half timber partitions.

We will trace (Fig. 4) one of these half timber frames, which belongs to the end of the 13 th century,[1] as much as one can judge by the mouldings. Here no gable walls are of masonry, as in the preceding example; the construction is entirely

in carpentry, and the party walls are half timber frames composed of sills, posts, struts and braces. The two stories of half timber front are corbelled beyond each other, as indicated by the section A. The corner and axial posts of the facade B are 8.7 and 9.4 ins. square; all the others and also the s sills and floor beams are only 6.7 × 7.5 ins. The floor beams C of the floors rest on the plates framed on the heads of the posts, are relieved by gussets and corbels D inside and outside, and can thus receive at their ends the sill of the story above. These floor beams being spaced about 3.3 ft. on centres receive weaker beams or rather joists on which are laid the boards with floor strips, space and tiles. The swaying of the half timber frame is prevented by quite strong braces E and X-braces below the sills of the windows. A detail (Fig. 5) e explains the connection of the sills a with the posts b, gussets and corbels c, either with these posts or with the beams e. One sees at g how the sills h are boxed into the ends of the beams, and how between these beams are set intermediate moulded blocks i. The perspective sketch f shows one of the beams separated and its mortises, the perspective sketch l represents the lintel m of the door and its connection with the post p forming the jamb. As for the elevation B, it explains the connection marked b in Fig. 4.

Note 1.p.42. From a house at Chateaudun.

This half timber frame is well drawn; the timbers are perfectly squared, the mouldings cleanly cut, the joints made with care. It is well understood to have been visible; the fillings were made with mortar and little rubble plastered.

We have elsewhere mentioned the skill [2] of the carpenters of the middle ages, chiefly during the 13 th, 14 th and 15 th centuries. It is unnecessary to believe that construction was then restricted to the use of half timber work for the houses of the citizens; on the contrary half timber work was a kind of construction often adopted even in public edifices, palaces and castles. In many feudal residences the buildings had inside, or as division walls, half timber framework. We have frequently proved the presence of these carpentry works, destroyed by fire, in castles of a certain importance. Half timber w work was also employed as a temporary means for enclosing edifices, which there was not time to complete, or whose const-

construction was suspended. Thus one sees at the top of the north wall of the cathedral of Amiens a gable in half timber work, that dates from the 14 th century.

In certain provinces where wood was abundant and stone rare, even churches were built entirely of wood. One still sees in one of the suburbs of the city of Troyes [1] a chapel placed under the name of S. Gilles, that is built of half timber work that dates from the second half of the 14 th century. That e edifice, from which recent additions have takey part of its character, consists of a single nave still entire, and terminated by an apse of four sides. We give (Fig. 6) at A the plan and at B the cross section of the chapel of S. Gilles.[1] The entire system consistr of a series of posts (one for each bay and at each angle) resting on a sill and supporting the trusses; a plate connects the tops, and two rows of ties with braces and little posts keep them upright. The tiebeams and kingposts of the carpentry are visible; that is ceiled. One spire of which a part is traced at D crowns the roof on the third bay, narrower than the others. Fig. 7 gives at A the geometrical detail of the connection of the parts with the tiebeams and the double braces that relieve them, and at B the perspective sketch of one bay of the interior with the window, the plate and the moulded upper ties. One sees how in that humble edifice the carpentrn is treated with care, how the decoration on the whole is only the appearance of the construction. On this woodworg is no plastering on laths imitating stone construction; thus this carpentry left to the free air on two surfaces has been preserved for more than four centuries. One will note that the braces C (Fig. 7) are intended less to relieve the tiebeams of the trusses than to prevent the canting of the half timber work. They take the place of angles or gussets, that prevent the entire system from swaying to one side or the other.

Note 1.p.45. Suburb Cronceus.

Note 1.p.48. M. Millet, diocesan architect of Troyes, has kindly furnished us the drawings of this little edifice.

After the 13 th century the timbers employed in half timber work are never very large; they are sound and are chosen from trees not too old. They are nearly always squared from a single trunk and consequently of small diameter. These good tra-

traditions were retained till the beginning of the 17 th century, since the treatise of Mathurin Jousse mentions them;[1] indeed there still exist some half timber works of that epoch, that are well hewn and made of selected wood.

Note 1.p.47. Le Treatre de l'art du charpentier, etc., by Mathurin Jousse de la Fleche 1627.

Principally in the provinces of the East and approaching the Rhine, we find remains of half timber structures of great dimensions. Strasburg has retained in these recent times wooden houses at larger scale than most of those seen in our cities of the royal domain. At Gonsta ce exist important public edifices in half timber work. Many of those houses of Strasburg, which date from the end of the 14 th and the 15 th centuries had defensive bays at the angles; they were large and high. Let us see how are generally combined the half timber fronts with the angle bays (Fig. 8). The front of the bay forms an angle of 45° with the front of the house (see the first floor plan A taken at the level c). At B is a corner post that rises from the bottom and from the sills to the plate S'. To this corner post is fastened the post C at the middle of the front of the bay. The angle posts E of the bay are diagonal and rest on the beams b b', whose overhangs are supported by the braces e. At the level of each floor the bay is connected to the principal structure by the floor beams (see the second plan D taken at the level d). The heads of the corner posts of the bay E receive the two horizontal plates h into which are tenoned the plates g (see the plan F of the last layout, taken at the level f). A little shed roof of planks covered by slates or shingles is set on blocks i, holds the lower part of the bay and serves as a shelter. This sort of construction gives much comfort to the houses by permitting one under cover to see the length of the street. The laterial framework supported the aransverse beams on whilh rest the floor beams. Thus those presented the inclination of the half timber work of the front, their ends being held between two plates or "columbelles," as were called those horizontal timbers.

The connection of the posts C at the middle of the front of the bay with the great corner posts B merits being detailed. The diagonal post B rising from the bottom (Fig. 9) is strongly chamfered on its corner forming the external angle, as ind-

indicated at O. A block P on that corner is arranged in the s solid below the chamfer, that has the width of one of the sides of the middle post C of the bay. On the support P is placed the strut M whose two tongues are inserted in the two mortises of the corner post. On that is fixed the block N by tenon and mortise, and it is further held by a tenon n rising i into the mortise n'. That block N receives in a mortise e the tenon e' of the post C, and in two side mortises the tenons of the girst S. The block N also supports the little rafter forming the shed roof. Dowels G of hard wood are pinned in t the corner post B and in the post C at certain distances, making these two posts stable. All other connections of the half timber construction are easy to understand and do not require explanation.

About the middle of the 15 th century was adopted a system of half timber construction that presented great strength, but which required complex workmanship. It consists of a lattice of timbers halved together so as to form a series of lozenge shapes. Thus are arranged the four half timber frames, that after the burning of the carpentry of the cathedral of Rheims in 1481 were intended to support a spire in carpentry, that was never erected. About the middle of the 16 th century the half timber fronts of private houses were built on this system, which was followed until Louis XIII. Also then were constructed half timber frames called "brins de fougere." as indicated by Mathurin Jousse in his work published for the first time in 1627. Several houses in Rouen and Orleans still show half timber facades so combined, and that present great stability because they have acquired perfect rigidity. If one compares them to these works, our modern half timber works plastered are very rude and have only a very limited duration.

PANNE. Purlin.

A timber in carpentry placed horizontally on the principals of roofs and intended to support the rafters. Most roofs built during the middle ages consist of a series of trussed rafters, consequently are without purlins. (Art. Charpente). Yet in o certain cases the carpenters of that epoch made use of purlins. The use of purlins became common when men had to economize t timbers of great length.

PARPAING. Through-stone.

Said of a stone forming the thickness of the wall. During the middle ages men rarely employed these stones. Nearly all out stone walls are composed of stretchers and headers. The stones A (See Fig.) are stretchers, stones B are headers; stones C are through-stones. (Art. Construction).

PARVIS. Yard before Church. Churchyard.

We shall not discuss the more or less ingenious etymologies that may have produced this word. By "parvis" is called an an enclosed area often raised above the surrounding soil, a sort of platform before the facades of some French churches.

Notre Dame of Paris, and Notre Dame of Rheims possessed their yards. Some monastic churches sometimes had yards before t their facades, but the latter had a special character.

This yard is evidently a tradition from antiquity; the temples of the Greeks were habitually preceded by a consecrated area, whose enclosure was only a barrier with the height of a sill.

The Romans followed that example, and we see on a medal struch on the occasion of the erection of the temple of Antonine and Faustina at Rome,[1] the facade of the monument before which is represented a barrier with a gate. These enclosures added to the respect that should surround every religious edifice, by isolating their entrance and separating them from the traffic on the public street. One of the most remarkable yards of the Roman epoch is that which Hadrian erected before the temple of the sun at Baalbec. That yard was enclosed by porticos with covered exedras, and was preceded by the front court with six sides with a peristyle and broad flight of steps.

Note 1.p.51. Divo Faustinae, on the reverse Aeternitas. Around the image of the temple, S. C.

The first Christian basilicas likewise possessed a court s surrounded by porticos before their facades, and in the middle of that court were placed some consecrated monuments, tombs, wells, fountains and statues.

The yard of our cathedrals is only a vestige of these traditions; but the French cathedral after the end of the 12 th century shows itself as an accessible monument made for the city and open to all assemblages; thus the yard no longer is

but a simple boundary that does not enclose; properly speaking, it is only a platform bounded by open and slightly raised works, no longer opposing an obstacle to the multitude; it is an area reserved for episcopal jurisdiction before the mother church.

In the enclosure of the yard the bishops caused to be erected those ladders on which were exposed the clerics, who had scandalized the city by their conduct; likewise on the pavement slabs of the yard certain blameworthy persons made atonement. Also on the yard were brought the relics on certain occasions, and where the clerics of an inferior order remained while the chapter intoned the Gloria from the external gates of the facade.

We have but very vague statements concerning the form of the old yard of Notre Dame of Paris. In the 16 th century it only consisted of a little base wall with three entrances, one opposite the portals and opening beside the chapel of S. Christophe; that at the left opening near the facade of S. John the Round, and the third being opposite the descent to the Seine.[2] This base wall was not over 4 ft. high. The ground level of t the yard was at the level of the internal floor of the church, except at the left side near the portal of the Virgin, where it was 1.0 to 1.3 ft. lower.[3] From the yard one descended to the bank of the river before the construction of the bridge by a flight of 13 marble steps. This causes the supposition that before the facade of the church extended a flight of 13 steps. It is to be believed that on the side next the Marche Neuf (new market), one also descended several steps to reach the public street, that passed between the hospital Hotel-Dieu a and the chapel of S. Christophe, but that flight of steps must have been removed after the 14 th century, since then mounted persons could reach the pavement of the yard. The enclosure was about 114.8 ft. wide by the same length.[1]

Note 2.p.51. See plan of Paris engraved on wood added to Recherches de Belle-Foretsa the plan of Merion; the tapestry of the city hall, and the engraving of the facade of Notre Dame by Van Merlen.

Note 3.p.51. That old pavement was discovered in 1847.

Note 1.p.52. We have been able to find at several places the foundations of that enclosure. Roman remains exist beneath the entire area of the present square, directly beneath the pave-

pavement; this proves that the level of the ground was at the level of the pavement of the church.

The yard of the cathedral of Rheims was much less extensive than that of Notre Dame of Paris, and remained entire until t the consecration of Louis XVI. It was a charming enclosure, a fragment of which remains along the external buttress at t the left of the facade. Drawings and engravings of that enclosure still exist and permit us to restore it. The plan of the yard of Notre Dame of Rheims does not present a parallelogram. but a trapezoid, as shown by the plan, Fig. 1. It was not elevated above the ground of the public street, like the yard of the cathedral of Paris, and the grand flight of steps ascending to the portal was placed inside the enclosure before the buttresses. The cut-off corner H (see plan) was arranged ts facilitate access to the entrance of the cloister, located at the north side of the nave.

The railing consisted of little piers bearing a rail with pinnacles at the entrances and the angles, i.e., at B. We g give at C the detail of this exterior of the enclosure and at D its return. The two pinnacles B′ at each side of the principal entrance were surmounted by supports with shields of arms; cross-flowers G terminated the other pinnacles.

The yard of the cathedral of Amiens has been removed; but its railing, if one were ever built, has not existed for a l long time.[2]

Note 2.p.52. This yard has become inaccessible and must soon be restored.

The yards of monastic churches with facades looking on a p public square were often established below the external ground; such was the yard of the abbey church of S. Denis.[3] The abbey church od S. Radegonde at Poitiers has till retained that very old arrangement, but restored about the end of the 15 th century. Fig. 2 presents a birdseye view of half the y yard, the axis being at A. Two descents are opened at the front. The ground declines toward the portal of the church; two other entrances are made on a level at the sides. Figures of kneeling angels holding shields of arms surmount the side walls of the two front entrances toward the outside. Animals, dogs and lions furnish the angles of the lateral entrances and the inner ends of the side walls of the front entrances. a B

higher part with shield presents itself on the axis. A section (Fig. 3) made of one of the front flights gives the detail of the arrangement of that enclosure. Benches were attached to the entire enclosure inside. The area of the yard was paved with stone slabs, and the water ran away through lateral exits.

Note 3.p.52. We have found traces of this pavement of this yard, to which one evidently descended from an early epoch, i.e., in the time of Suger.

It is unnecessary to emphasize the monumental effect of those enclosed areas before the churches. Sometimes as before the portal of the abbey church of Cluny, a stone cross was erected at the middle of the yard; tombs were built within the enclosure. These arrangements, like most of those belonging to the dignity of the cathedral or abbey church, were removed by the abbots and chapters during the last (18 th) century. These areas were abandoned to dealers for a rental during days of fairs, and then were soon covered by permanent stalls. For some rentals, the clergy of the cathedrals and abbeys thus alienated the property of the church; they first raised the hammer against all that should inspire respect for consecrated monuments.

PATIENCE. Miserere.

A little seat in the form of a corbel placed beneath the movable seat of the stalls, and serving as a support when that is raised. (Art. Stalle).

PAVAGE. Pavement. Paving.

The paving of the public streets, squares, courts of palaces, is a work that is not seen to be undertaken, except in a civilized state. As all know, the Romans paid great attention to paving the streets of cities, and everywhere that they sojourned are found those great hard stones, granite, sandstones, lava and basalt, set irregularly by a rammer, and forming on a layer of concrete a very uniform surface with a monumental appearance. These pavements were established to last for several centuries, and indeed served during the first times in the middle ages. Not being renewed or even maintained, they gradually deteriorated and were filled to close the deepest holes, disappearing under a thick layer of mud and dust. The

great streets of the Gallo-Roman cities during the Carlovingian period retained well or badly the antique pavements, but the sewers were obstructed, the pavements were broken, and t those streets only formed unclean sewers. Yet already in the 12 th century were paved certain squares or frequentel streets.

We have sometimes discovered remains of these pavements, h habitually made of small cubes of sandstone or other resistant stone.[1] (Fig. 1).

Note 1.p.55. In the city of Paris, at Vezelay, Senlis, Provins, Coucy-le-Chateau.

Philip August passes for having paved the streets of Paris with great blocks of sandstone.[2] William the Breton claims t that this pavement was made of very large square stones. There exists no trace of that pavement. When a few years since the foundations of the little Chatelet were uncovered to rebuild the bridge Petit-Pont, there were removed quite a large quantity of paving blocks of sandstone placed about 3.3 ft. below the existing surface. These blocks were about 1.3 ft. square and 0.7 ft. thick. Very much wear on their upper surfaces. They must have served for a very long time, and they probably dated from the epoch of the construction of the Chatelet (end of the 12 th century). During the 15 th and 16 th centuries were often employed boulders for paving the public streets, courts and squares. These boulders were tamped on a bed of sand, as still practised in some cities of the South of France, notably at Toulouse. At Paris,Rue de la Juiverie was repaved on this system as an experiment during the League.

When the incline was steep, the streets were paved with hard stones set on edge. We have found pavements of that kind in a good state of preservation around the castle of Pierrefonds.

Note 2.p.55. William of Nangis, Chronicon, 1184. Edit. by Society of History of France. Vol. I. p.78.

The lower stories of houses were often paved, and there were still seen a few years since houses of the middle ages, w where the ground in the lower story was covered by little cubes of stone about 4 ins. on the side, set pointed on a bed of mortar or cement.

PEINTURE. Painting. Mural Painting.

The further back one goes toward ancient times, the more one

recognizes that there existed an intimate alliance between architecture and painting. All edifices of India, Asia Minor, Egypt and Greece, were covered by paintings inside and outside. The architecture of the Dorians, of Attica, Magna Grecia and Etruria, was painted. The Romans appear to have been the first, who erected under the empire monuments of white marble or stone without any coloring; as for their coatings of stucco, they were colored externally and internally. The barbaric peoples of northern and western Europe painted their houses and wooden temples, and the Scandinavians lavished brilliant colors and gilding in their habitations.

We must only consider here those facts well known to archaeologists, and only occupy ourselves with painting applied to the French architecture of the middle ages. Then as during t the good period of antiquity, painting seems never to have been separated from architecture. These two arts mutually aided each other, and what we now call the picture did not exist, or at least it had only a very secondary importance. Gregory of Tours mentions on several occasions the paintings that decorated the religious edifices and palaces of his time. "And then (the soldiers besieging the city of Comminges said to Gondovald), "art thou that painter, who in the time of king Clotaire daubed with lattices the walls and vaults of oratories?" [1] When that prelate repaired the basilicas of S. Perpetua at Tours, he caused them to be "painted and decorated by the workmen of the country with all the splendor that they had formerly." [1] That custom of painting edifices continued during the entire Carlovingian period, and Frodoard informs us that bishop Hincmar, rebuilding the cathedral of Rheims, "ornamented the vault by paintings, lighted the church by glazed windows, and caused it to be paved with marble. [2] Researches made in the architecture called Romanesque prove, that painting was considered the necessary finish for every civil a and religious edifice, and then by preference was applied to ornamental sculpture or statuary, to mouldings and profiles, as if to emphasize the importance and value. However, when that architecture assumed an original character, when it dropped Gallo-Roman traditions, i.e., about the end of the 11 th century, painting was applied to it by a special method, as if to better exhibit the proportions and forms. We do not know

very well, according to what principle painting covered the carlovingian monuments of the West, and to guide us in our researches, we have only certain churches in Italy, for example like S. Vitale of Ravenna, some mosaics still existing in the basilicas of Rome or Venice; and in those remains the effect of the colorings obtained by means of those millions of little cubes of glass or of hard stone combined, is not always in accord with the architectural forms. Besides this mode of coloring gives to the walls of vaults a metallic appearance, that harmonizes neither with marble, nor for a stronger reason with the stone or the stucco of columns, piers, bands, plinths, etc. The mosaic called Byzantine always has something barbaric; one is surprised and preoccupied; those tones of extraordinary intensity, those singular reflections that modify the forms and destroy the lines cannot suit peoples for whom architecture, first of all is an art of proportions and combinations of lines. It is certain that the Greeks of antiquity, who still regarded coloring as necessary to architecture, were too much lovers of form to have admitted the mosaic termed Byzantine in their monuments. They knew painting only as a uniform, dull and fine coloring, leaving to the lines their purity, even accenting them, and expressing the most delicate details.

Note 1.p.58. Latin note. Greg. Tur. Hist. France. Book VII. Chap. 38.

Note 1.p.57. Latin note. Book X. Chap. 31. Sect. 19.

Note 2.p.57. Frodoord. Hist. de l'Eglise de Reims. Chap.5.

Painting applied to architecture can only proceed in two ways; either it is subject to the lines, forms and design of the construction; or it takes no account of them and extends independently over the walls, vaults, piers and mouldings.

In the first case it forms an essential part of the architecture; in the second it becomes a furnishing decoration, if one can so express himself, that has its special laws, and often destroys the architectural effect to substitute for it an effect belonging only to the art of the painter. That the painters regard this last kind of decoration as the sole good, is nothing to surprise one; but that the art gains by it is a question that merits discussion. Painting was separated from architecture only at a very recent epoch, i.e., at the moment

of the Renaissance. From tha day that the picture, the isolated painting made in the studio of the painter, was substituted for painting applied to the wall that must retain it, painted architectural decoration has been lost. The architect and the painter have worked separately, daily deepening the chasm that separates them, and when by chance they have endeavored to reunite on a common ground, it is found that they no longer understand each other, and that desiring to act in concert, there no longer exists any bond that can reunite them. The pa painter accuses the architect of not having arranged suitable places for him, and the architect believes himself right in declaring that the painter takes no account of his architectural arrangements. This separation of two arts, once sisters, is visible, when one casts his eyes on the attempts made in o our days to harmonize them. It is clear that in these attempts the architect has not conceived or seen the effect that s should be produced by painting applied on the surfaces that he prepares, and that the painter regards those surfaces only as a canvas stretched in a studio less convenient than his own, besides caring little for what there may be around his painting. Thus he cannot comprehend the decorative painting during the middle ages, nor even during the Renaissance, and Michelangelo in painting the vault of the Sistine Chapel did not isolate himself, he wa indeed conscious of the place where he worked, of the effect of the entirety that he desired to produce. If one paints on a wall instead of on canvas, it does not follow that the work may have a monumental painting, and nearly all mural paintings produced in our time are always only paintings, in spite of the difference in procedure; thus we see that these paintings seek a frame, that they are grouped in scenes having each a view point, a particular perspective, or that they extend in processions between two horizontal lines. Not thus p proceeded the old masters of mosaic, nor the western painters of the middle ages. As for the painting of ornament, chance, instinct and imitation alone serve today as guides, and nine times out of ten it would be difficult to say why a certain o ornament takes that form rather than another, why it is red a and not blue. One has what is called taste, and it is believed that this suffices for decorating by illuminations the interior of a church; or indeed he collects everywhere fragments

of paintings and applies them indifferently, this that was on a column goes on a plane surface, the other that was seen on a tympanum is on a plinth. The public is shocked by this medly, and finds that with a good effect, but it is demonstrated to them, that the decorators of the middle ages have been scrupulously consulted, and the same public concludes from this that the decorators of the middle ages were barbarians, which is further very willingly agreed to.

In the decoration of architecture it is true, that it is n necessary to admit, that the painting is perhaps the most difficult part, and what demands the most reflection and experience. When one painted the interiors of all edifices, the richest as well as the poorest, he necessarily had data and rules that he loffowed by tradition; the most ordinary artists then could not go astray, but today those traditions are absolutely lost, everyone seeks an unknown law; thus one should not be astonished if most of the attempts made have only produced unsatisfactory results.

The 12 th century attained the climax of the art of architectural painting during the middle ages in France; stained glass, vignettes of manuscripts and the fragments of mural paintings of that epoch emphasize a learned and very advanced art, a singular alliance of harmony of tones, the coincidence of this harmony with the forms of the architecture. It is not doubtful that this art was developed in the cloisters and proceeded from Grecian-Byzantine art. Then the most beautiful fabrics, furniture, colored utensils, even a great number of manuscripts, brought from the Orient were contained in the treasuries and libraries of monasteries, and served as models for the monks devoted to art works. Later, about the end of the 12 th century, when architecture left the monasteries and was practised by the lay school, occurred a revolution in the art of painting, which without being as radical as that made in architecture, however profoundly modified the principles established by the monastic school.

Without speaking at greater length of some scarcely visible fragments of painting, of formless traces that appeared on o certain monuments before the 11 th century, we shall only state that from the Gallo-Roman epoch, i.e., about the 4 th century, all the monuments appear to have been painted inside a

and outside. That painting was applied either on the stone itself, or on the plastering covering the masonry walls, and for parts elevated above the ground it only consisted of a so sort of whitewash or yellowish wash, on which were traced very fine lines in black or red ochre. Near the ground appeared sustained tones, reddish brown or even black, relieved by some yellow, greenish or white bands. The sculptures themselves were covered by this thin wash, the ornaments being detached on red grounds and often enhanced by black lines and yellow touches.[1] This sort of painted decoration appears to have long been practised among the Greeks, and up to the moment when Charlemagne invited artists from Italy and the East, That last foreign influence however was not the only one, which must lead to the art of monumental painting, such as we see it developed in the 12 th century. The Saxons and Normans covered with painted ornaments their houses, utensils, arms and ships; there exist in the library of ~~the library of~~ the British museum vignettes of Saxon manuscripts of the 11 th century, that in drawing, delicacy of execution and general harmony of tones, are of surprising beauty.[1] That art evidently came from northern India, from that source common to all peoples that have known how to harmonize colors. The facility with which the Normans, when scarcely established on the soil of Gaul, exercised and even developed the art of architecture, the already refined mode of living to which the Saxons had arrived at the moment of the invasion of William the Bastard, sufficiently indicates that these peoples had in themselves something else than the instincts of pillagers, and that they came from families that had long possessed certain ideas of art. But first it is necessary to understand well what is the art of painting applied to architecture. In our time has come such great confusion in all these questions of art, that it is well first to state the principles. What is understood by a people of colorists (to use a sanctioned expression, however bad it may be), i.e., the Venetians, the Flemings for example, the Hindoos, Chinese, Japanese, Persians, and even the Egyptians of antiquity. To obtain a charming effect in a painting by means of sacrifices skilfully made, by an exaggeration of certain tones given by nature, by a very delicate accord of half tints, as could be done either by Titian, Rembrandt

or Metzu, and make a Tibetan shawl, these are two very distinct operations of the mind. There is only one Titian, one Rembrandt and one Metzu, and all the weavers of India came to make woolen scarfs, which without one exception give harmonious combinations of colors. That one Titian or one Rembrandt may develop requires a social atmosphere extremely civilized in all points; but the most ignorant Tibetan, living in a w wooden hut, in the midst of a family as miserable as himself, will weave a shawl whose rich assemblage of colors will charm our eyes, and can be but imperfectly imitated by our best directed manufactories. The more or less barbarous condition of a people, from our point of view, then is no obstacle to the development of a certain part of the art of painting applicable to monumental decoration; yet one should not conclude from this, that when a people is very civilized, it cannot attain or return to monumental art; witness the Moors in Spain, a v very civilized people, who in fact produced excellent models in painting applied to architecture; and while the art of the painter, as understood since the 16 th century, has arrived at a very high degree of perfection, at the same time one cannot have an architectural painting; witness the Venetians of the 15 th and 16 th centuries. A single conclusion is to be deduced from the preceding observations; this is that the art of the painter of pictures and the art of the painter applied to architecture proceed very differently, that to desire to combine these two arts is to attempt the impossible. Some lines suffice to emphasize this impossibility. What is a picture? It is a scene that one causes the spectator to see through a frame, an open window. Unity of point of sight, unity of d direction of the light and unity of effect. To properly view a picture, there is but one single point, located on the perpendicular erected at the point on the horizon, that is called the point of sight. For every delicate eye, to view a picture outside that single condition is a pain, as it is torture to find one's self before a theatre decoration above or below the horizon line. Many persons suffer torment without mistrusting it we admit; but it is not on the coarseness of the senses of the greatest number, that we can establish the rules of the art.

Note 1.p.39. We have seen many traces of this sort of pain-

paintings on fragments of Gallo-Roman monuments of the late time; unfortunately these traces rapidly disappear on contact with the air.

Note 1.p.60. Among others see the manuscripts of the Liby. Cott. Nero. Evang. lat. Box.

Then starting from this rigorous condition imposed on the picture, we do not understand a picture, i.e., a scene represented according to the rules of perspective, light and effect, so placed that the spectator finds himself 13.1 or 16.4 ft. below its horizon, and very far to the right or left from the point of sight. The brilliant epochs of the art never admitted such enormities; or indeed the painters (as during the middle ages) have not taken into account in the subjects painted at all heights on the walls, either of a horizon, of a real place, of perspective effect or of a single light; or indeed those painters (like those of the 16 th and 17 th centuries) have resolutely attacked the difficulty by tracing the scenes, that they desired to represent on the walls or under the ceiling of a hall, according to a single perspective, assuming th that all the personages or objects shown to the spectator were actually placed where represented, and consequently presenting themselves in an aspect determined by that place itself. Thus one sees in the ceilings of that epoch personages by the soles of their feet, certain figures whose knees conceal their chests. Naturally that fashion of deceiving the eye had a great success. Yet it is clear that if in that manner of monumental decoration, the horizon is a sumed to be placed 6.6 ft. above the ground, at the real height of the eye of the spectator, there can only be a single point of sight on all that horizontal surface assumed at 6.6 ft. from the pavement. Now from the moment that one leaves that single point, the perspective drawing of all that decoration becomes false, all the lines appear to dance, and make seasick the persons that have the habit of wishing to take account of what their eyes cause them to perceive. When the art has fallen into these errors, to desire to leave the domain assigned to it, it soon ceases to exist; it is the dangerous leap that replaces eloquence, the juggler that takes the place of the orator. But still the artists that have adopted this kind of decorative painting h have been able to adopt one point, a single one we say, from

which the spectator can experience complete satisfaction, as they believe; it would be little for the entire surface of a wall to give a single point, from which one could perfectly seize the decoration, but finally it would be something. The scenes represented further find themselves framed in the midst of an ornamentation that itself affects the reality of the reliefs, shadows and lights playing on the projecting bodies. This was an ornamental system possessing its unity and its r reasons, while one cannot find the reason for this system of painting, for example, which beside scenes representing the reality of effects, shadows and lights, and perspective, places flat ornaments composed of contiguous tones. Then the scenes that represent the actual effect produced by the relief of the differences of planes are in complete dissonance with that flat ornamentation. It was not without reason that the painters of the middle ages saw in painting, either that it represented scenes, or that it was only composed of ornaments, a surface that must always appear plane and solid, that was not intended to produce an illusion, but a harmony. We admit that some prefer the deceptive painting of the vault of the great Jesuit church at Rome to that of the vault of S. Savin near Poitiers; but what we cannot admit, is that some pretend to harmonize these two opposed principles. It is necessary to declare for one of the two.

If painting and architecture are united in an intimate alliance of art during the middle ages, by a stronger reason the painting of figures and ornaments formed only a single ornamental covering. The same mind conceived the composition of t the scene and that of the ornamentation, the same hand drew and colored both, and the monumental paintings could not have the appearance of pictures surrounded by wall-paper, as too frequently occurs today, when one makes what he desires to c call mural paintings, that are indeed only paintings pasted on the wall, enclosed by a frame, that instead of isolating them as would the ordinary frame of gilded wood, injures and extinguishes them, reduces them to the state of a dark or light spot, deranges the effect, takes the eyes too much and w wearies the spectator. When the painting of scenes on the walls of an edifice is not treated like the ornamentation itself, it is naturally killed by that; it is necessary either that t

the ornamentation be treated to deceive the eye, if the subject enters the domains of reality, or that the subject be treated as an illuminated drawing, if the ornamentation is flat.

These principles established, we shall first occupy ourselves with the monumental painting of subjects. We have stated that Greek art was the first school of our western painters from the point of view of iconography and that of execution. Yet from the 11 th century in France (and these remain to us in monumental paintings of subjects preceding that epoch) one recognizes in the manner of treating the drawing an independence, a truth of expression in pose, that one does not perceive in the so-called Byzantine paintings of the same epoch. To recover that independence in Greek painting, it will be necessary to examine the Byzantine manuscripts of the 8 th and 9 th centuries;[1] later that Grecian art became fixed and fell into a narrow routine that it never left. Not only our artists of the 11 th century took their models in the paintings of Grecian style, but they even took possession of the material processes adopted by the Byzantines; we find the evident proof of this in the treatise of the monk Theophilus, who lived in the 12 th century. The outlines of the paintings of S. Savin [2] were made with the brush; they consist of reddish brown lines. "The colors were applied in broad flat washes without indicating the shadows, to the point that it is impossible to determine from what side the light comes. Yet in general the projections are indicated in light and the contours are accented by darker tints; but it seems that the artist had in view only to obtain a sort of conventional modeling, nearly what es seen in our arabesque painting. In the draperies, all folds are marked by dark lines (brownish red), whatever the color of the material. the projections are accented by o other white lines quite badly blended with the general tint." (Those lines are not blended, but indicated by hatchings more or less wide painted on the tone of the fabric). "There are cast shadows nowhere, and as for aerial perspective, or even linear perspective, it is evident that the artists of S. Savin did not trouble themselves about it." [3]

Note 1.p.83. The Imperial Library possesses some of these of rare beauty.

Note 2.p.83. These paintings in great part date from the

second half of the 11 th century.

Note 3.p.83. See Notice sur des peintures de l'eglise de S. Savin. -- M. Merimee, from whom we borrow this passage, adds a little later these observations, that we must mention. "Almost always the figures are detached on a light and prominent color, but it is difficult to divine what the painter desired to represent. Often a series of parallel lines of different tints presents the appearance of tapestry; but that I think, is only a species of capricious ornamentation, without any pretense of truth, and the sole aim of the artist seems to have been to emphasize the personages and accessories essential to his subject. In truth, these accessories are only a sort of hieroglyphics or purely conventional images. Thus the clouds, trees, rocks and buildings do not give the least idea of imitation; they are rather in a way, graphical explanations added to groups of figures for understanding the compositions.

Surfeited today by the search for truth in little details, that modern art has carried so far, we have difficulty in understanding that artists formerly have found a public, that accepted such rude conventions. Yet nothing is easier to produce than illusion, even with naive means, that seems so far from it. Assuredly a stage wall of marble with its immovable decoration, did not prevent the Greeks from being interested in an act, that must occur in a forest or among the rocks of the Caucasus; and the audience of Shakespeare seeing two lances crossed at the back of the barn that served as a theatre, understood that a battle occurred; the incident was agitating, and everyone trembled at the cries of Richard offering his ki kingdom for a horse.

Beside that indifference to accessory details, or if you p prefer, that primitive ignorance, one sometimes notes a very correct imitation of a feeling of very acute observation in the attitudes and poses of the personages. The heads, although without expression, are often distinguished by a singular nobility and a regularity of features, that recalls, it is true very rudely, the types that we admire in antique art."

In fact, in the painting of subjects, each figure presents an outline vigorously detached on a light ground, or in light c color on a dark ground, only enriched by lines that indicate the forms, folds of drapery and the internal lines. The model-

modeling is obtained only by those more or less accented lines, all in the same brown tone, and the color is nothing but an illumination. The paintings on the so-called Etruscan vases, those discovered in the tombs of Corneto, proceed absolutely in the same manner. There the accessories are treated l like hieroglyphs, the human figure alone being developed according to its real form. A palace is rendered by two columns and a pediment, a tree by a branch surmounted by some leaves, a river by a winding line, etc. When monumental painting is concerned, can one produce on the spectator as much effect by these primitive means as by the use of deceptions? Or to speak more correctly, when men are born in the midst of a civilization where one is accustomed to estimate painting according to the greater or lesses reality obtained, can they be affected before objects treated is are those of the tombs of Corneto, those of the catacombs, or those of the church of S. Savin? That is the entire question, only a qnestion of edecation.

A child is quite as much charmed, if not more so, before an illuminated drawing as before a painting by Rubens. It is not stated that this drawing is barbaric and without value as art. On the contrary, let this drawing be reproduced in beautiful forms, be pure in style and the illumination be harmonious; if the spectator is moved before that interpretation of nature, is not that a homage rendered to art? And does not art thus prove that it is a power? If for an easel painting one gradually attains a fine and complete imitation of the subject chosen, producing light effects of extreme delicacy, concentrating so to speak the attention of the spectator on a scene rendered by the aid of scrupulous observation with perfect distinctness, certainly we do not complain, since to that advance we owe the masterpieces that fill our galleries, and which are one of t the glories of western civilization since the 16 th century. But the art suitable for the framed canvas, the picture, whatever its dimensions, has no relation to that destined to cover the walls and vaults of a hall. In the picture we see only an isolated expansion of a single art, and we isolate ourselves to observe it; it is again a window that we open on a scene suited to charm and move us. Is it the same in a hall that is covered by paintings? Is not there a mixture of several a arts? Should these proceed in isolation or produce an effect

of entirety? The reply cannot be doubtful.

If we examine the attempts that have been made to harmonize the two opposed principles of painting taken as isolated and of painting purely monumental, do we not perceive at once the rock on which the greatest talents have struck? And the vault of the Sistine Chapel itself, in spite of the prodigious genius of the artist that conceived and executed it, is it not an episode that shocks rather than charms? Yet Michelangelo, architect and painter, as much as the programme imposed on h him allowed him, knew so well how to combine his subjects and his figures with the ornamentation, for the place occupied, t that the unity of the vault is complete. But what becomes of the hall? From the decorative point of view, what becomes of the painting of the last judgment under the crushing conception?

In the Sistine Chapel, one must isolate himself to observe the vault, likewise to see the last judgment, and forget the hall. One remembers the vault, but recollects very imperfectly the judgment, unless he knows it from engravings; as for the hall, he does not know that it exists. Now the arts are not made to destroy each other, but to aid and enhance each other; at least they were so understood in the best epochs. M Much is pardoned to a genius like Michelangelo for suppressing what surrounds him and for injuring himself at need, effacing some of his own works to make a single one resplendent; that caprice of a giant is only ridiculous in men of ordinary capacity; yet it has turned the heads of all painters since the 16 th century, it is so true that the example of even men of genius is baneful, when they abandon true principles, and that one should never allow himself to be guided other than by principles. From Michelangelo to Carrachi is but a step, and who are the successors of Caracchi?

Artistic peoples have seen in monumental painting only an illumined drawing very slightly modeled. If the design be beautiful, the illumination harmonious, monumental painting says all that can be said; the difficulty is certainly very great and the result obtained is considerable, for only by the aid of those means apparently so simple, that one can produce those grand effects of colored decoration, whose impression remains deeply graved in the mind.

We have stated that the Greek painters were the first mast-

masters of our western artists; but in Greece (we speak of B Byzantine Greece) painting retained a hieratic form from which it rapidly freed itself among us. Already in the 13 th century, Willian Durand, bishop of Mende, wrote in his Rationale divinum officiorum,[1] in quoting this passage of Horace:- (see Latin text).

Note 1.p.88. Book I. Chapter 3.

That homage rendered to the freedom that should be left to the artist makes a strong contrast to the rigor of the traditions of the Byzantine school, preserved almost intact until our days.[2] In style as well as in the work of the processes of the paintings produced in France during the 11 th and 12 th centuries, one recognizes exactly the instructions of Denis, the Greek author of the Guide de la Peinture. We again fi find the recipes of this Greek master of the 11 th century in the treatise of the monk Theophilus [3] (12 th century), and e even again in the work of the Italian painter Cennino Cenneni, who lived in the 14 th century;[4] but if the artists of the middle ages long retained the processes furnished by the Byzantine school, they very promptly freed themselves from the hieratic traditions, we may say, and sought their inspiration in the observation of nature. However (and that is to be yoted), in giving to the style of their works a character gradually less traditional, our western artists and especially in France, knew how to leave to their paintings a decorative harmony until the middle of the 15 th century, maintaining the principle of a design illuminated and lightly modeled. Our artists in France, in what concerns the drawing, the correct observation of the pose, composition and even expression, freed themselves before the Italian masters; the paintings and vignettes remaining to us from the 13 th century are the proof of this, and fifty years before Giotto we possessed in France paintings, which had already made in the art the advance attributed to t the pupil of Cimabue.[1] From the end of the 12 th to the 15 th centuries the drawing was modified. At first bound to Byzantine traditions, it soon rejected these conventional school m methods, and sought principles derived from an observation of nature, yet without abandoning the style, the study and pose soon attained rare delicacy, and then came the search for what is called expression. The modeling without attaining effect

applied to markink tne planes. One recognizes remarkable effects of composition in the second half of the 13 th century. The dramatic idea is adopted, and tne scenes sometimes assume a movement of powerful energy. About the middle of the 14 th century, from fine and delicate, the drawing already tends toward mannerism; the accepted types are lost to be replaced by the imitation of individual nature; the exaggeration of this mode is sensible at tne beginning of the 15 th century, to t the point that the ugly is introduced into tne art of painting, and too soon possesses itself of the entire form. At the same time one recognizes that the skill of the hand is extreme, tn that the artists possess excellent procedures, and that they push to excess the seacch for detail, minuteness in execution, in the study of the accessories.

Note 2.p.66. On this subject see Manuel d'iconographic chretienne, translated from the Byzantine manuscript; Guide de la Peinture, by Dr. Paul Durand, with an introduction and notes by M. Didron. Denis, author of the Guide, lived in the 11 th century.

"The following canon," says M. Didron in one of his notes (Introduction, p.3), "of the second council of Nicea, compared to tne passage of the bishop of Mende, marvellously expresses the condition of dependence in which the Greek artists lived. (Latin canon). In fact the council of Nicea did not do entirely wrong, and tne most beautiful Byzantine paintings known are certainly the oldest.

Note 3.p.66. Diversorum artium schedula, published by count d'Escolopter. 1848.

Note 4.p.66. See edition of this work published at Rome in 1821 by chevalier Giuseppe Tombroni.

Note 1.p.67. There is won ing for our artists a Vasari, an exclusive apologist. This is a misfortune, but does that diminish their merit? Is it for us to reproach them with the oblivion in which we have left them?

The coloration suffers transformations less rapid; the harmony of monumental painting is always subject to a principle essentially decorative; tnis harmony changes the tonality, it is true, but it is always a narmony applicable to subjects as to ornaments. Thus in the 12 th century, for example, this harmony is absolutely that of Greek paintings, all vern light for

the grounds. For figures as for ornaments the local tone, which is the color that replaces what we call half tint; parts light and almost white on all projections; modeling brown, u uniform for all shades; delicate line eithe in light on the large dark parts or in brown on the large light portions, so as to avoid spots in the entirety. Colors broken and never absolute,[2] at least on the large parts; sometimes the use of b black to enhance. Gold adopted as embroidery, brilliant parts, halos; never or very rarely as the ground. Dominant colors are yellow ochre, light brownish red, green of various tones; secondary colors rose purple, light violet purple, light blue. Always with a brown line between each juxtaposed color. Further, it is rare in the harmony of the paintings of the 12 th century, that one finds two colors of equal value placed beside each other without having between them a color of inferior value. Thus for example, between brownish red and a green of equal value, there will be a yellow or a very light blue; between a blue and a green of equal value will be a light rose purple. General appearance soft and witniut shock, light and with very vivid firmness obtained by the brown line or the w white touches. Full colors dominate, particularly blue and red. Green only serves as a means of transition, the grounds become dark, brownish red, deep blue, even sometimes black, gold, but in this case always netted. White only appears as lines or d delicate touches; yellow ochre is only employed for accessories; the modeling is based on,and partakes of the local color. The tones are always separated by a very dark brown or even black line. Gold already appeared in mass on the vestments, o but it is either netted or accompanied by brown touches. The flesh is light. General appearance warm and brilliant, uniformly sustained, even dark, unless revived by gold. About the end of the 13 th century the tonality becomes harder; black o often appears, very intense blue or brownish red, retouched with black; on the other hand, the vestments assume light colors, rose, light green, yellowish rose, very light blue; the use of gold is le s frequent; white, and especially grayish white, greenish white, covers the draperies. These are sometimes polychrome, for example white, with transverse red o bands embroidered with white, black or gold. The flesh is nearly always white in the 14 th century, gray tones, grayish

green, light rose, dominate; the blue is always modified; if it appears pure, this is only in the ground and it is kept light. Gold is rare; the black, brownish red or yellow ochre grounds persist; the brown drawing is strongly accented, and the modeling is very light. White touches no longer exist, but black or brown touches are frequent; the flesh is very light. The general appearance is cold. The drawing infringes on the coloration, and it seems that the painter feared to lessen t the value by the opposition of brilliant tones. About the second half of the 14 th century, the grounds are charged with varied colors like a mosaic, or present damascenings of tone on tone. The draperies and the flesh remain light; black disappears in the gronnds, it only serves to outline the forms; gold combines with the mosaic of the grounds; the accessories are light, in grisaille enhanced by light tones or gold ornaments. The general appearance is soft and brilliant; the colors are much divided, while at the beginning of the 15 th century they appear in patches, warm and intense. Then the modeling is carried very far, although the single direction of the light may not be clearly determined. The projecting parts are the lightest, and this results from the procedure employed in decorative painting. But in the grounds, the accessories, trees, palaces, buildings, etc., are already treated in a more real manner; linear perspective is sometimes sought, but as for a aerial perspective, it was still not considered. Fabrics are rendered with skill, the flesh is very delicately modeled; so gold mingles a little everywhere, on vertments, on the hair, on the details and accessories, and one does not see those s sacrifices justly regarded as necessary in the painting of pictures. The most insignificant accessory is painted with as much care, and is as much in the light as the principal personage. There is one of the conditions of monumental painting. On the walls of a hall viewed obliquely, what the eye demands as a general sustained harmony, a surface uniformly solid and rich, not pierced or with planes concealed by sacrificed tones, that derange the proportions of the system of the architecture. These general principles being established, we pass to the s study of the styles of the painting of subjects and to that of the processes employed.

Note 2.p.67. That arises from the procedure employed, as we shall indicate immediately.

We have stated above that the most ancient paintings that we possessed in France, presenting a tolerably complete entirety, are those of the church of S. Savin near Poitiers. In these paintings, as we have again stated, although one again finds the traditions of the Byzantine school, yet he observes a certain freedom of composition, a true study of pose, a dramatic tendency, that no longer exists in the Greek painting of the 11 th century, then bound to invariable types. In the frescos of S. Savin beside a personage evidently represented according to a hieratic tradition, the artist has given to groups of figures attitudes studied from nature. Some scenes even have a dramatic movement very vigorously rendered, in spite of the imperfections and crudeness of the drawing. Among others, we shall cite the scenes from the Apocalypse painted beneath the porch; in the church beneath the vault, the offerings of Cain and Abel, the flight into Egypt, the construction of the tower of Babel, the drunkenness of Noah, the burial of Abraham (Fig. 1); Joseph sold by his brothers; Joseph accused by the wife of Potiphar. In these compositions is noted a grandeur, a true and strong feeling, even boldness, that sufficiently show that this school of Poitou did not restrict itself to the dry reproduction of Byzantine paintings. But later, in the 12 th century, we find French paintings scrupulously submitting to Greek traditions; such are those of the chapel of Liget,[1] whose drawing, types, compositions and modeling approach exactly to the school of Byzantium,[2] to the degree that one could attribute them to an artist of that school.

Note 1.p.69. Department of Indre-et-Loire.

Note 2.p.69. See the copies of those paintings made with a scrupulous care by M. Soulnien petit (Archives des monuments historiques).

In the paintings of the chapel of Liget, if the art be subject to a sort of archaism, one feels a seeking for the beautiful, and perceives the last rays of antiquity, still so p brilliant in the catacombs of Christian Rome. Fig. 2 gives one of the personages painted on the walls of the chapel of Liget, and suffices to emphasize the relations existing between that art of the 12 th century and that of the primitive epochs of Byzantine painting. The tones of these paintings are soft, t the drawing is broad and firm. The colors are; light yellow f

for the chasuble with brown ornaments; green for the cowl turned down, white for the robe; light brownish red for the maniple and the halo, as well as for the ground. The drawing is sustained and with a brown line.

During the period of the middle ages comprised between the 10 th and the end of the 12 th centuries, in the art of painting more than in architecture in France was then a diversity of schools and experiments, here an entire submission to the Byzantine masters, there attempts at emancipation, observation of nature, study of pose, search for dramatic effect. For example in Auvergne in the 12 th century existed a powerful school of painting, restricted in execution, beautiful in style, so far as the fragments, now rare, permit us to appreciate it. But then (at the end of the 12 th century) the attention of the peoples of the North of the Loire seemed to concentrate themselves on the development of the new architecture. Then abandoned the subjects painted on the walls to devote themselves to the execution of translucent painting of glass. Further, the newly inaugurated architecture no longer offered to the artists those great plane surfaces suitable for painting. Painting was limited to the coloring of sculpture and to the d decorations obtained by the combination of ornaments. But in the cartoons of their glass, the painters had opportunity to largely develop their talent, and art did not remain stationary. When the fever of architecture that took possession of the peoples of the royal domain had calmed a little, the painting of subjects was seen to reappear on the internal surfaces of edifices; and one could recognize the immense advance that it had made in the attentive observation of nature, in the search for the beautiful and in execution. It is indeed necessary however to recognize, that it had lost much from t the point of view of the grand style, as antiquity had understood it; it already tended toward mannerism and exaggeration of expression; the pose was always true, the drawing refined, but grandeur gave place to the search for a certain already coquettish grace.

Villard of Honnecourt, who lived then (from 1250 to 1270), has left us precious statements on the methods of painters of his time.[1] The vignettes of this manuscript reproduced in facsimile in Plates 34, 35, 36 and 37, give us certain practical

procedures for obtaining the attitudes and poses of figures by means of combinations of straight lines or arcs of circles and geometrical figures; we shall limit ourselves to presenting here a single one of the examples given, so as better to show the methods on which Villard relied.

Note 1.p.72. See Album of Villard of Honnecourt, manuscript published in fac-simile with notes by Lassus and commentaries by A. Darcel. Delion. Paris. 1858.

Here (Fig. 3) are two wrestlers, that the draftsman seems to have desired to show as having equal strength.[2] The procedure of drawing is this. (Fig. 4). Take the equilateral triangle A B C, whose base A B is divided into two equal parts, and gives two other secondary equilateral triangles. The axial line D C being extended, on this extension at E we take a point as centre of the circular arcs F G, H I. Having marked two points O, O, on the arc F G, these points are the centres of the arcs K L. Thus the sides of the great equilateral triangle and the sides of the two little triangles give us the direction of the legs of the wrestlers; the two arcs F G, H I, give the movement of the knees and trunks; the arcs K L the lines of the backs of the two figures. From which results the stability of the persons and the relations of their attitudes. Villard was not a painter but an architect, and gives only a certain number of figures obtained by means of geometrical t traces and principally by triangles; but it suffices us to know thus the practical methods employed by draftsmen of figures; methods that compelled the most mediocre artists to confine themselves to the observation of certain very simple laws of easy application, by the aid of which then remained at least withing proper limits, even if they had not sufficiently elevated merit to produce masterpieces.

Note 2.p.72. This Figure is copied in fac-simile.

In the French paintings of the 13 th century that remain to us, archaic art, still retained during the period of the 1[illegible] th century, was abandoned; the artists not only sought truth in the pose, but a flexibility in it, already distant from the rigidity of Byzantine drawing. The drawing became freer and the observation of nature more delicate. The example that [illegible] give here (Fig. [illegible]), copied from a fragment of a painting of t the end of the 13 th century,[1] explains in what consists this

this change or rather this advance in the art. Here three fourths of the head of the Virgin is finely drawn. The pose does not lack suppleness, the draperies are drawn with a freedom a and remarkable breadth by means of a brownish red line.[2] One sees that the painter must have worked on a transfer that gave only a general mass, an outline and some principal features, and that the details have been rendered by the point of the brush. Even certain corrections have been left visible in the bottom of the mantle at the left side. Frequently these mural paintings are actual improvisations; those artists made cartoons only for subjects studied with exceptional care. Now to draw as a **transfer a figure** of natural size, it was necessary to possess sure and very certain methods.

Note 2.p.73. The coloring of this painting has almost entirely disappeared.

The Byzantine painters, neither then nor today made cartoons; they painted directly on the wall. During the middle ages in the West men proceeded in the same manner; this is what explains the absolute utility of the recipes given in the Guide de la peinture cited above, in the essay of the monk Theophilus, and in the treatise of Cennino Cennini. Besides, how did those artists, who covered in brief time very extensive surfaces, h have time to make cartoons; at most they could prepare rough sketches at a reduced scale. During the 12 th and 13 th centuries, lines incised in the fresh plaster are seen only exceptionally, and those lines always indicate transfer from a cartoon; on the contrary, one frequently perceives light lines made with the brush, covered by the coating of color on which is laid the definite line, that is a mode of modeling. This definite line corrects and rectifies the primitive sketch, s sometimes entirely modifying it, and we know scarcely any paintings of the 12 th, 13 th and 14 th centuries without corrections.

The painters of the 12 th century employed several kinds of paintings: fresco, size, egg, and oil painting. The last for lack of a dryer was only employed for small works; pictures on panels that one could easily expose to the sun. For the use of fresco painting, i.e., on a coating of fresh plaster, as u we have just stated, the artist commenced by tracing with red ochre dissolved in pure water the masses of his personages,

then he laid the local tone that formed the half tint by successive coats, mixing lime with the tint; he modeled the projecting parts, adding a larger portion of lime as he came to the last coats; then with reddish brown mixed with black, he redrew the outlines of the folds, the hollows, and the internal lines of the nude or of the draperies.

This operation must be done rapidly, so as not to allow the plaster and the first coats to dry entirely. This mode of painting in the paste gives a softness and particular brilliancy to this kind of work, and a modeling that even from an intense blue coming to nearly pure white on the projecting or light parts, is neither dry nor discordant, each superposed tone soaking into and participating in the lower tone. The s-skill of the practician consists in knowing exactly the degree of dryness to be left to each coat before applying a new one. If that coat be too wet, the applied tone wets it again and forms with it a spotted, heavy and dirty mud; if it be t too dry, the applied tone does not adhere nor join, and forms a dark ring on its outline. The blackish brown line, so necessary and that accents the outlines of the internal forms, shadows, folds, etc., was often laid when the modeling by successive coats was dry, so as to obtain more vivacity and distinctness. Then it was sized with egg or with size from skins. Thus in those old frescos, one frequently sees this brown line detached in scales, not forming a part of the coating.

The use of lime as a base and even as a luminous addition to each tone, only allowed the painter to use certain colors, s such as the earths, cobalt blue and green. That requirement of only using the earths and a very small number of mineral colors contributes to giving these paintings a very soft harmony, so to speak, velvety. In the 13 th century that harmony appeared too pale in comparison to the colored glass, that ga gave tones of prodigious intensity, and they must renounce f fresco painting, so as to be able to employ the lead oxides, copper greens, and even lakes. Further, the architecture adopted not permitting plastering, it was necessary to find a process of painting, that would facilitate its direct application to the stone. Indeed, various procedures were employed. Those most common are:- painting with eggs, a sort of light and stable dilution; painting of size from skins or bones, also very

durable when not exposed to dampness. The most stable is painting with resin dissolved in alcohol, but this quite expensive process was only employed for delicate works. Also sometimes men were contented with milk of lime applied as a base, o on which one painted in water color before that coating of l lime laid with brushes had dried. Painting with oil was very clearly indicated by the monk Theophilus, and was adopted before him, since he does not give himself as its inventor, but as we said before, it was employed only on panels, because of the time necessary to leave for each coating to dry in the sun, dryers not yet being in use.

Note 1.p.76. Theophilus says that"one could grind colors of all kinds with the same kind of oil (linseed oil), and place them on a work in wood, but only on articles that could be d dried in the sun; for each time that a color is applied, you cannot apply another, if the first is not dry; which for images and other paintings is long and very wearisome." (Book I, chapter 27).

Painting with gum was employed in the 12 th century, and s seems to have been very frequently practised by the painters of the 13 th century for small objects, reredoses, woodwork, etc. "If you wish to hasten your work," says Theophilus,[2] "t "take the gum that oozes from the cherry or plum trees, and c cutting it into small bits, place it in an earthen pot; pour in water abundantly, then expose it to the sun or indeed in winter on a gentle fire, until the gum is melted. Mix carefully with a stick and pass through a cloth; grind the colors w with it and apply them. All colors and their mixtures can be ground and laid by the help of this gum, except red lead, w white lead and carmine, which must be ground and applied with white of egg." These paintings with gum or even with oil were habitually covered by a varnish composed of gum arabic dissolved in linseed oil by heat;[3] they had an extraordinary brilliancy.

Note 2.p.76. Book I, Chapter 27.

Note 3.p.76. Theophilus. Chapter 21.

The artists of the 13 th century, in painting subjects in halls fitted with colored glass, adhered to giving them a brilliancy and solidity of tone superior to the painting of ornament, and that could compete with the gold very frequently em-

employed then. To obtain that brilliancy, they must make use of glazing, and indeed the coloring of figures, when they are produced with some care, is chiefly obtained by applications of transparent colors on a preparation modeled in strong relief like a stucco. Those artists, either by tradition or by instinct, had the feeling for harmony (their glass is an evident proof for every one). From the day that gold became a s strong part of the decoration, it became necessary to modify the soft and light harmony adopted by the painters of the 12 th century. Gold is a metal and not a color, and its presence on large surfaces in painting compels the painter to change the entire scale of his tones. Gold has very vivid and light reflections, very bright half tints and shadows of an intensity and warmth, near which all colors become gray if light, obscure and heavy if dark.[1] To be able to compete with these so brilliant lights and those half tints of Gold so warm, very strong colored tones are necessary, but which not to appear black must retain the transparency of a water color. Thus were treated the small subjects decorating the arcade of the upper S. Chapelle of the palace at Paris. Those subjects, that are alternately detached on a ground damascened with gilding or of netted gold, were painted very light, then enhanced by a very vivid transparent coloring and brown lines. Yet with gold, all these tones were not treated in the same manner; blues and light (turquoise) greens are pasty, and so applied assume a strongly coloring value; while reds, dark greens, purples and yellows, need to be applied as a glaze to retain a brilliancy able to compete with the half tints of gold. This glazing seems to have been stuck by means of resinous gluten, perhaps only by the aid of that varnish composed of linseed oil and gum arabic. As for the painting underneath or paste, it is fine and is applied on a very thin layer of lime; yet it is not fresco, for this painting scales and forms a glaze.

Note 1.p.77. We have examples of the effect that gold produces beside fresco tones, those with wax or even pasty with oil. White vestments on a gold ground appear dirty, gray and dull, and the flesh is heavy. The only tones that sustain themselves on gold grounds are the transparent tones that can be obtained by glazing. And also it is necessary to make on the gold either a network, a strong lattice or a mosaic. The vou-

vaults of the Stanze painted by Raphael in the Vatican supply us with observations of great interest in that respect; particularly that of the hall of the disputation on the holy sacrament. The gold grounds are cracked like mosaics, and the f fresco subjects have a vigor of coloring, that could only be obtained by retouching, either with egg or in some manner applied with glazing. The same observation can be made in the library of Siena, by examining the apsidal vault of church S. Maria del Popolo, attributed to Pinturicchio.

It even frequently occurred to artists painting subjects or ornaments on gold grounds, to gild the underside of the ornaments on draperies intended to be colored red, purple or yellow tenged reddish brown. Then the coloring was only a very transparent glaze laid on the metal, and with very intense t tones they avoided heaviness. Those tones participated with the ground, and retained something of its metallic splendor.

The dearness of paintings in which gold plays an important part, the difficulties and consequences of employing this metal, which restricts the painter at every step to retaining everywhere a brilliant harmony, very sustained without falling into heaviness, caused that about the end of the 13 th century, as we have stated, that men freouently adopted the system of grisaille. They went so far in the coloring of glass about the middle of the 13 th century; that crushing coloration had led painters to give to the tones of their paintings such brilliancy and intensity, that it was necessary to recede. Then much glass was made in grisaille or they used limpter and translucent coloring; gold no longer plays in painting but a very secondary part, and the subjects were colored in soft and very light tones, and to avoid the flat and faded effect of these scarcely illuminated reliefs, they were supported by very strong grounds, black, reddish brown, intense blue, often charged with drawings, tone on tone or d damascenings of varied colors, but presenting a very vigorous mass. They thought little then of perspective grounds, but c commenced to give the accessories, like chairs and furniture, an actual appearance. Gradually the field of imitation extended; after having painted only objects directly touching the figures, according to their form and true dimensions, then p placed an edifice, door or tree on a secondary plane; then

finally the conventional and purely ornamental grounds disappeared, to give place to a real interpretation of the place or the scene that occurred. Yet it is necessary to state that if the painters before the 16 th century sought to give an a actual representation of the place, as we have already stated, they did not think of aerial perspective nor of the effect, i.e., of the distribution of the light on a principal point, nor to produce illusion, and that their paintings always retained the appearance of a decorated plane surface, which we believe to be one of the essential conditions of monumental painting.

We cannot extend farther, without leaving the scope of this Article,on the painting of subjects in edifices. Besides we shall have occasion to return to some points concerning painting in Articles Style and Vitrail. We shall now pass to the painting of ornament, to painted decoration properly so-called. There is reason to believe that on this important part of the art, the artists of the middle ages had only traditions and daily experience, but few or no theories. The treatises on p painting only occupy themselves with the material means, and do not enter into considerations on the art, on the methods to be employed in certain cases. For us, who have absolutely lost those traditions, and who possess only a very limited e experience of the decorative effect of painting, we must necessarily base ourselves on the observation of past examples to restore certain theories resulting from that experience a and those traditions. It would be useless to our readers to know that such an ornament is yellow or blue, if we do not e explain why it is yellow here and blue there, and how it produces a certain effect in one or the other case. Decorative p painting is before all a question of harmony, and there is no harmonic system, that cannot be explained.

Decorative painting is further one part of the art of architecture difficult to apply, precisely because the laws are e essentially variable because of the location of the object. Decorative painting enlarges or dwarfs an edifice, makes it light or dark, changes or accents its proportions; causes it to recede or approach, makes it pleasing or wearisome, separates or combines, conceals defects or exaggerates them. It is a fairy that lavishes good or bad, but which never remains in-

indifferent. At its pleasure, it enlarges or lessens columns, lengthens or shortens piers, raises the vaults or brings them nearer the eye, enlarges or diminishes the surfaces; charms or offends, concentrates the idea in one impression or distracts and occupies without cause. By a stroke of the brush it destroys a wisely conceived work, but also of a humble edifice it makes a work full of charm, of a cold and bare hall, a pleasant place where one loves to dream, and retains an ineffaceable memory.

In the middle ages were required to execute those prodigies, excellent masters, such as each city supplies one or two? Certainly not; it required only some working painters acting on the principles derived from long observation of the effects, and that can be produced by the assemblage of colors and the scale of the ornaments. Then the poorest village church whitewashed with some touches of painting was a work of art, just like the S. Chapelle, and there were not seen in the midst of the same civilization works of art of great value or at least of surprising richness, and at some steps from there those d distressing decorative paintings, that dishonor the walls that they cover, and cause to blush all men of taste that see them.

As everyone knows, there are only three colors, yellow, red and blue;, white and black being two negations; the white being uncolored light and black the absence of light. From these three colors are derived all tones, i.e., infinite mixtures. Yellow and blue produce greens, red and blue the purples, and red and yellow the oranges. In these colors and their mixtures the presence of white and black increases the light or lessens it. Precisely because white and black are two negations and are foreign to the colors, they are destined in decoration to accent the values. White radiates, black emphasizes and limits radiation. The decorative painters of the middle ages, either by instinct or rather by tradition, never colored without a complement of white or black, often with both. Passing from the simple to the compound, we shall explain their methods. We shall speak only of the painting of interiors, of those lighted by diffused light; we shall occupy ourselves in the last place with external painting, i.e., lighted by direct light. During the period of the middle ages, when monumental painting plays an important part, we observe tha the artist

adopts at first a tonality from which he does not depart in t the same place. Now these tonalities are not numerous and reduce to three; the tonality obtained by yellow and red with the luminous and dark complement, i.e., white and black; the toanilty obtained with yellow, red and blue, which necessarily brings in the intermediate tones, i.e., green, purple and orange, always with the complement of white and black, or b black alone; the tonality produced by the aid of all tones given by the three colors, but with as complement , black as the dark element, the luminous refceltions of gold in this case replacing the white.

Assuming that the vaule of yellow is 1, red is 2 and blue 3; mixing yellow and red we obtain orange with the value 3; yellow and blue give green with the value 4; red and blue make purple with value of 5. If we place these coors on a surface, so that a harmonious effect be not exceeded, using only yellow and red, it is necessary that the area occupied by the yellow be at least double the area occupied by the red. But if we add blue at the time, the harmony becomes more complex; the p presence of blue alone requires, either a considerable relative increase of the yellow and red areas, or the complement of green and purple tones, which for green should not exceed one fourth, and for purple not over the fifth of the total s surface. These are the elementary rules of the harmony of the decorative painting of the artists of the middle ages. Also they have rarely admitted all the colors of the tones derived from their mixture, because of innumerable difficultion resulting from their juxtaposition, and from the relative importance of the area, that must be occupied by each of those tones. In the case of adopting the three colors and their derivatives, gold becomes an indispensable complement, for it is charged with completing or even reestablishing the harmony. Returning to the simplest principles, one can obtain a perfect harmony with yellow and red (red ochre), especially with the aid of the white complement; it is impossible to obtain a harmony w with nellow and blue, or even with red and blue, without the complement of the intermediate tones. If you would decorate a hall with an entirely white background with red and blue or yellow and blue ornaments, even if sprinkled, harmony would be impossible. Red (red ochre) and yellow (yellow ochre) being the only two

colors than can find themselves together without the complement of other tones.

The observation of other principles as elementary was no less familiar to those artists. For example, they had recognized that the same form of ornament in white or a light tone on a black ground, or black on a light ground, changed its d dimensions. To make ourselves fully understood (Fig. 6), let at A be reddish brown squares on a white ground, at B being white on a reddish brown ground; the brown squares will appear smaller than the white squares, the farther one removes from the painted surfaces, and the surface occupied by the white ground will seem larger than that occupied by the brown ground. Let there be two pilasters of the same widths and the same heights; if one of them at C be decorated by vertical lines, at a distance it will appear taller and narrower than that at D ornamented by horizontal bands. And to return to the preceding observation on the harmonic value of the colors, r red being assumed to be 2 and blue 3, the red must then occupy a larger area than the blue to obtain harmony between these two colors; if (Fig. 6) the squares A be blue on a red ground, it will be possible to have a harmonious surface; but on the contrary if the ground is blue and the squares are red, the eye will be so shocked, that it cannot remain an instant on t that surface, the assemblage of the two colors in the last c conditions will cause the outlines to waver to the point of causing vertigo. Everyone can make this experiment by employing pure vermilion for red and ultramarine for the blue. Not only do the colors have an absolute value, but also a relative value from the place that they occupy, and the area that t they cover; further, they modify the actual areas of the colors according to the form of the ornament that they color. In the simplest tonality, that in which yellow (ochre) and red (ochre) are employed, it is clear that one of the two colors, the red ochre, has more intensity than the yellow; but if to those two colors we add blue, it is necessary for the value of the red and blue to be different, for the red yields to the blue, or which is most natural, that the blue yields to the red. Thus it is the brownish red that must be admitted and light blue; if we add (further almost by force) tones derived from these three colors, like green and purple, it is

equally necessary to establish these tones and these colors according to the different values, i.e., to never have two to-tones of equal values. It no longer concerns the surface occupied but the intensity; now that intensity is optional. If wh when we employ only the three colors, the red must be brownish red and have the greatest intensity, employing with these three colors the derivatives, the red must become pure, i.e., vermilion, because brownish red can harmonize neither with green nor with purple; the addition of the derived tones require the colors to be pure if one employs them. Still it is well for the primary value to be left to a color rather than to a tone; this primary color cannot be given to yellow, it will be the red tone (vermilion),or the blue that I will assume it (usually blue). Let us assume that this be the intense blue that has the primary value; the painters of the middle ages refrained from giving a second value to another color, i.e., to red; they assigned it to a tone, most frequently green and sometimes purple. Then comes the third value, which will be the red (vermilion); then between this color and the yellow is another tone, habitually purple, sometimes green. After the yellow come the inferior values, very light purples (rose), light blues, turquoise greens, straw yellows, milky white and grays. For below the lowest color value, which is necessarily yellow ochre are required tones, never the scale of values ending with a color, as it rarely does not commence by a tone.[1] These principles being known, there still remain a number of rules of a secondary order, that these artists of the middle ages scrupulously observed. We shall cite some of them. Intense blue being hard and cold, the painters frequently have it a little greenish, and have relieved it by spots of gold; they they have nearly always placed beside it a vivid red (vermilion), then after the red a light green or even a bluish or greenish white, black lines further separating each tone of color. Blue in direct contact with yellow produces an equivocal effect, and red or purple is interposed. Slaty gray blue alone can lie on a yellow surface. Green is often placed in direct contact with blue, and this is a dissonance employed with rare skill, but then the green inclines to yellow or blue and the green is dark. The purples have in area the value 5, and consequently must occupy the smallest fi-

field in the painted decoration, never approaching violet; t thi false tone being absolutely excluded, it inclines toward orange or madder. We have frequently observed how ingenious is nature in the harmonious combination of the tones of plants; thus for ten geraniums or hollyhocks that have flowers of different reds or purples, we shall see ten different green tones for the leaves, all green tones being each combined for the red or purple that they surround. Had the painters of the middle ages studied the secrets of the harmony of tones from nature? We do not know; but how is it that those secrets are lost, or that women alone possess them, when it concerns their attire? Why when it is necessary to paint a hall, do our artists seem to apply colors by chance, producing in the entirety a false harmony almost always? Is this from lack of principles, traditions and practice? It is certain that in the difficult art of painted decoration instinct does not suffice, as some think, and that in this important part of architecture, reasoning and calculation intervene as in all others, for lack of a long series of traditions.

Note 1.p.83. The S. Chapelle of the palace presents the most curious example of this chromatic scale. In spite of the numerous and broad traces of the old tones, the difficulties were numerous in the restoration of the paintings; it was necessary to make the tones many times over, for lack of consummate experience. On placing a tone whose trace was certain, it was frequently necessary to change the value of the upper or lower tones.

The simplest decorative painting, that requiring the fewest combinations, is that obtained with yellow ochre, red ochre or brownish red, black, white and gray, a mixture of the two. This painting is only a drawing, so to speak, a grisaille of a warm tone, yet it can already produce very varied effects. Yellow ochre and red ochre are two colors of the same family, so to speak, that always harmonize without difficulties. Whether you paint a yellow ornament on brownish red, or a brownish red ornament on a yellow ground, whatever be the form or dimensions of the ornament, it will not make a spot; but if you enhance the yellow or brownish red ornament by black or white lines, you will then obtain effects of extreme delicacy and rich in tone. This observation can be made in the halls

of the keep of Coucy. The painted decoration of the hall of the ground story only consists of a jointing traced in white with brownish white bands on a ground of yellow ochre. The s side arches of the vault consist (see their section at A, F Fig. 7) of a square angle with running ornament from a to b and from b to c, then a moulding whose members are alternately painted red and yellow ochre. We give at B, B′ and B″, three specimens of these running ornaments on the two faces of the square angle. That at B is brownish red on an ochre ground with broad black lines on the edges of the leaves and a w white line at an equal distance from the edge, laid on the middle of the black line. That at B′ is darkened yellow (yellow color mixed with red ochre) on yellow ochre ground outlined by very dark brownish red lines and white lines inside them; white spots are further noted on the yellow ground; that at B″ is brownish red outlined by a white line on yellow ground with slaty gray bands G. The effect of this ornamentation is most brilliant. It is unnecessary to state that the same ornament is found on each side arch on the two faces a b, b c, and is doubled. Some green tones are seen on the capitals of this hall and vermilion tones on the ribs of the vaults, but there as an absence of blue, gray sometimes replacing that c color. Green and slaty gray enter into this simple harmony w without difficulty, and it seems that the artists of the 12 th century and the beginning of the 13 th shrank from the use of blue, which as we have just stated, directly requires the use of tones varied between blue and red, or blue and yellow. There exists in the edifice known at Poitiers by the name of the temple of S. Jean, paintings of the 12 th century that p present the richest combinations of simple harmony. One of t the surfaces of the principal hall presents with figures colored yellow, light reddish brown, green, grayish green and s slaty gray, bands of which we give two specimens. That at A f forms the upper frieze below the carpentry, that at B taking the place of the raised sill below the windows. The band A is composed of an oblique fret colored brownish red, yellow ochre and green on a milky white ground. A white line forms the front edge of the fret. Each tone of the fret is modeled by means of parallel hatchings and a darker tone, wides as they approach the lower border of each oblique face. The tones are

marked thus; brownish red by the letter R; yellow by J, Green by V, slaty gray by BG. The birds are brownish red and yellow. The white dots are regularly placed on the upper and lower horizontal bands. At that epoch in the 12 th century white dots (pearls) are very frequently employed on brownish red a and yellow tones, frequently astride between the two; this was one means for giving an affected appearance to the painting for removing their crudity from absolute tones. It is well to note that tha brownish reds of these paintings are of remarkable brightness, transparent and vivid, without having the hardness of red (vermilion). The second example that we give at B is on a light slaty gray ground; the values are yellow, the florets are light brownish red with the middle a dark brownish red; these yellow and red ornaments are bordered by a white line. The harmony of the tones of this specimen is of extreme delicacy and at the same time very solid. Men painted at that epoch, i.e., during the 12 th and beginning of the 13 th centuries, most edifices not only in the interior but on the exterior, and the harmonic system of those paintings is always based on this simple system, with rare exceptions. Y Yet they was made a quantity of stained glass, that acquired the greater richness in color as the windows became larger. (Art. Vitrail). If with windows of small dimensions filled w with white or very light glass, under a diffused and not extensive light, it was natural and even necessary to give the decorative painting a both brilliant and soft appearance, when men assumed the habit of placing strongly colored glass before openings intended to light the interiors, that light painting in transparent tones was completely extinguished by the intensity of the tones of the new glass. Blue and red entering for a great part into the translucent coloring of the glass, gave an equivocal appearance to the ochre tones, the greens became gray and dull, the white disappeared or assumed rainbow tints. With the colored glass were required brilliant tones on the walls, and again for these tones to have their value, they must be accompanied and outlined with black like the colored glass itself. Thus we see that during the 13 th century the harmony of decorative painting of interiors was modified. If by reasons of economy there were retained large light surfaces, occupied only by bands; the bands, ribs of vaults, their

tympanums, are strongly colored, and that coloring is more p brilliant, the farther they are from the eye. We have a remarkable example of this transition from the harmonic system of decorative painting in the old church of the Jacobins of Agen, built about the middle of the 13 th century. This church, according to the custom established by the order of S. Dominic, consists of two naves separated by a row of piers. Painted w with simplicity, yet one sees that the artist desired to sustain the brilliant effect of the glass, that formerly filled the windows. Each bay of that wall (Fig. 9) consists of a dia-per limited by the engaged piers and the side arch of the vault. A relatively narrow window opens in the middle of that d diaper. At A is laid a uniform dark tone with bands; above is traced a jointing, in brownish red on a white ground from B to C. A band is painted at D; the tympanum over that band is occupied by a white ground with two shields of arms. This painting is then of extreme simplicity; the vaults are richer; not only are the ribs colored as well as the bosses, but beneath the intrados of the filling triangles from the central boss to the crowns of the side arches are wide bands A (Fig. 10), covered by painted ornaments of beautiful designs. As for the triangles B, they are only occupied by jointing traced in brownish red on a white ground. Now et is necessary to observe that the blue color only appears in the ornaments and on the shields of arms. All the diapers receive no other tones than yellow ochre, brownish red, black and milky white. Thus in Fig. 11 the bands indicated at D in the bay, Fig. 9, are colored in two tones, yellow ochre and brownish red with white parts and black grounds. The stems of the scrolls are alternately yellow and red, as well as the leaves and the branches of grapes. The yellow leaves are outlined with red and black on a white ground, the red leaves are laid flat. Two wide bands are yellow inside and red outside and stop the black ground. These bands vary in design in each bay, while retaining the same harmony. The ribs of the vaults, whose section is given at 3, Fig. 12, are each covered by varied ornaments, two specimens of which we give at G'H. These ornaments only account for half the section, i.e., for the design G, the middle o the rib being at a', the edge b falls at b', and the edge c at c'. For the rig G the stars are purple, bordered by int-

internal white and external black lines; the eye is yellow a and bordered by black; the ground is intense blue (indigo). For the rib H the leaves are yellow bordered by internal white and external black lines, the rosettes are white with yellow eye bordered by a black line; the grounds are alternately intense blue and red; green appeared on other ribs. As for t the bands from the bosses of the triangles, we give a specimen in Fig. 13. All these bands are varied, but all have the design detached on a black ground; the frets are brownish red, light blue and white with a white line on the front edge. The palms are white with some parts in very light blue, modeled by means of brownish red hatchings. The harmonic system of c coloring of this hall,-- for this church is properly only a hall with two naves,-- is this: -- for the vertical parts, walls and diapers, the simplest harmony, that given by yellow and red tones on white ground with black touches; but for the vaults, farther from the eye and that could be seen only through the atmosphere colored by the light passing through glass in brilliant tones, a harmony in which light blue and intense blue intervened, and consequently purple and green, the whole enhanced by black grounds and lines, black grounds for the bands of the triangles of the vaults, black lines only to outline the ornaments of the ribs. Indeed, the black outline became necessary when one passed to a harmony composed of three colors, yellow, red and blue with their derivatives; for if there is such a great difference in value between yellow and reddish brown, that it is not necessary to separate the brownish red from yellow ochre by a black line, it was not so when were placed beside each other two colors with values little different, like purple and blue, blue and red, light blue and yellow, green and purple, etc.; the black line then becomes absolutely necessary to prevent the wavering of one tone on the other, and consequently the decomposition of one of them. Thus if you place a blue tone directly beside a purple tone, you will make the purple grayish and doubtful if the blue is intense, or the blue will be light azure or even lilac, if the purple is vivid. The farther distant one is from the painted object, the more complete will be this decomposition of one of the two tones, and sometimes of both. But if between this blue and purple you interpose a black line and even a u

white line doubling the black, as in example 3 (Fig. 12), you will isolate each tone and will restore their value to each; they influence each other without confusing and consequently injuring each other; they contribute to a harmouy, precisely because each retains its own quality, and that they act, (excuse the word) in the fullne s of that quality. For an accord to occur in music, it is necessary for each of the given notes to concur in the accord and to be accurate; but if a single note be false, the accord will not exist. Well! It is the same in decorative painting; for an accord to exist, it is necessary that each tone must retain all its purity on its own part; for it to preserve this, it is essential that its coloration or value be not falsified by the mixture of an adjacen tone, a mixture especially made at a distance, if one has not taken care to enclose each tone by black, which is not a tone. White alone will be insufficient to produce this effect, because white is colored and affected by the radiation of adjacent tones. Black is absolute and it alone can enclose each tone. It is then necessary to establish between the tones of a decorative paintiug that harmonic scale of values mentioned above, but it is also necessary to take into complete account the more or less pronounced radiation of these tones; a radiation that increases with the distance at which t the eye is placed. Thus for example, blue radiates more thau any other color. A blue touch on a yellow ground and near the eye scarcely changes the yellow; at a distance the same blue touch will make the yellow appear dirty green and the blue grayish. If the blue touch be outlined by a black line, the yellow will be changed less; if between the blue touch and t the yellow you interpose a black line and a reddish brown line, the yellow ground will retain its real value, and the brownish red will entirely outline the blue, which will remain pure.

The decorative painters of the middle ages carried as far as possible this knowledge of the value of tones, aud their influence of their harmony; and if the attempts made in our days have scarcely succeeded, it is not to be attributed to those painters, but to our nearly complete ignorance of these matters. The simple harmonic system for the vertical parts nearest the eye, already compound for the vaults, employed in the cnu

church of the Jacobins of Agen, establishes a transition most interesting to observe. The decorators of that hall were sparing with blue, and yet employing it only on very small surfaces, they have immediately accepted purple, green and black lines. They admitted only two blue tones, intense blue (value of indigo but less azure), the light blue (cobalt mixed with white); as for the purple, it is brilliant, like what one could obtain with glazing madder lake with a dot of mineral blue on a base of mine-orange applied light. The green touches, also very rare, are vivid and tend to yellow. The brownish reds are brilliant, having a value of vermilion with more transparency. The yellows are of the most beautiful ochre mixed with a dot of vermilion. There is not a bit of gold; this is because gold is required by the presence of blue on a large area. We have just stated, that blue is a color that radiates more then any other, i.e., that its presence changes all the other tones up to a certain point; with blue the red wavers, yellow turns g greenish, the intermediate tones turn grayish or are discordant. Gold alone by its metallic reflections can reestablish harmony between the tones, when blue appears on a great area. Gold has that singular quality, although it gives a scale of yellow tones, not to be turned green by blue and not to change its gleam. It takes in its shadows warm tones, that take the place of the brownish red, that we interposed above between yellow ochre and blue; in the half tints it acquires greenish reflections that have a strong value and make blue azure. In the lights it sparkles and assumes a splendor that can be changed by no tone, however brilliant it may be. Gold thus becomes like a theme dominating the harmony, a theme sufficiently powerful to maintain harmony between tones however they clash. It prevents the radiation of blue, and it makes it so azure, that it is necessary to tinge it green so that it may not appear v violet; it lightens red (vermilion) by the extraordinary warmth of its shadows; it gives to greens a splendor that they could not have beside blue surfaces; it warms purples by its greenish half tints. Then it is not a vulgar desire to give richness to a painted decoration, that caused the use of gold in such great quantity during the 13 th century, but the need of harmony imposed by the use of blue on large areas, and the use of blue on large surfaces is required by colored glass.

This question merits examination. In the 12 th century, as we have seen, men had adopted a simple and clear decorative harmony, composed of white, yellow tones, brownish red, greenish, slaty gray and grayish black. When they came to place very vividly colored glass, and the light illuminating the interiors was decomposed by the interposition of this glass, they soon perceived that these light tonesbecame heavier and assumed a doubtful aspect; the black lines were multiplied to restore brightness to these paintings; but the black itself became grayish under the radiation from the colored glass. Blue touches were applied, but it was difficult to harmonize these with the yellow ochres, and those blues formed spots on small surfaces. Then the bold method was adopted, and they dared to cover the vaults entirely with blue, not a pale blue like certain decorations of the Romanesque epoch, but a pure blue, vivid and brilliant. Only one experiment of that kind was necessary to show that this boldness must modify the entire system of decorative painting. At first the blue vaults illuminated by the decomposed light of the glass assumed such an azure a appearance, that they appeared almost violet, with a heavy t tone that nothing could support. On those blue vaults was tried, as a corrective and to restore to the blue its real value, the placing of red touches, but the wavering of the red on the blue only made that color more azure. They tried white stars, but the white stars seemed gray' then finally were applied g gold stars. Immediately the blue resumed its value, and instead of appearing to crush the interior, it raised it and acquired transparency. Either those touches of gold caught the light, or when they remained in the shadow; in the first case their yellow gleam, brilliant and metallic, softened the blue tone; in the second their value of very warm yellowish brown made it bluer. Thus one could modify this blue tone without inconvenience, and it was made slightly greenish to remove all appearance of violet. But this starting point, so intense, brilliant and powerful, must change the entire scale of tones accepted until then. To sustain blue vaults enriched by gold spots, no color was too brilliant or too intense, and it was necessary to admit vermilion, even vermilion glazed with lake, brilliant greens, transparent purples, and in the midst of all

to throw gold as a harmonic element, prominent and dominating all. Men even went so far as to use grounds of enamel or of glass colored and gilded imitating enamel, gilded networks and glass bead work. This comprised the coloring of the S. Ch Chapelle of the palace. No sort of decoration is more attractive than painting. If you place a tone, it is necessary to p place all the others to preserve the accord; the first layer of color that you place on one part is a sort of engagement that you impose on yourself, which must be rigorously kept t till the end, under penalty of producing only a repulsive daub. For a long time men have got out of the difficulty with gold; when the harmony cannot be endured, when it has not been calculated, they lavish gold. But gold (pardon the expression) is a spice, and not a food; in scattering it everywhere, always on all occasions, perhaps it is only a confession of weakness. There are paintings of very rich appearance without the admission of gold in the least particle. Gold is almost compulsory as a complement of blue; but one can produce a very brilliant effect without blue, and consequently without gold. The paintings of the keep of Coucy, into which enters not a bit of blue or gold, are vivid, gay and harmonious, warm and rich. Those of the refectory of the commandery of the temple at Metz,[1] have a marvellous splendor, and neither gold nor blue are found there. That painting dates from the first half of the 13 th century; it decorates a hall composed of two naves, with a row of columns supporting a ceiling of carpentry (Fig. 14,, plan 7). On the columns is placed a girder that receives the floor beams. The girder, beams and the surfaces of the wall are entirely covered by paintings. At B we indicate the painting of the walls, whose ground is changed in design in each bay. The entire ornamentation comprises only white for the ground, yellow (ochre) and red (ochre). Between the beams a is a design representing animals in strong brownish red detached from a white ground. Below is a frieze b with white ornament on a light brownish red ground, with outlines of dark brownish red. Then opposite each column of canopy c is likewise traced in brownish red with a figure d. Between the canopies the grounds e are composed of brownish red diaper on w white. The base f consists of wide dentils of brownish red with intervals g in yellow ochre and foliage of light brown-

brownish red enriched by black lines. The underside of the g girder gives the design n composed of wavy lines of brownish red on white and wide yellow borders. The beams i are all varied; some represent white and vair on gray ground with brownish red bands; others have chevrons alternately white, red a and yellow,separated by black lines. On the sides of the girder are presented knights charging, painted and outlined in brownish red on a white ground with rosettes also red. The entire decoration of this hall then consists of but two tones, yellow ochre and red ochre on a white ground with some rare gray touches. By the aid of such simple means, the artist however has obtained a very brilliant effect, very vivid and in perfect harmony. But here neither blue nor gold appear in the painting.

Note 1.p.94. Today this refectory is comprised within the works of the citadel of Metz; it serves as a storehouse for forage.

One will observe that the parts representing architectural members, like the canopy c, for example, do not pretend to imitate a decoration in relief. This painted architecture is purely conventional; it is a hieroglyph. Men did not think then of making an illusion, any more than during good antiquity. This fashion of interpreting certain architectural forms merits some attention, as it is an important part of this art. It is unnecessary to reproduce accurately the relative dimensions, th modeling and the actual appearance of relief, of mouldings and capitals, but to interpret these forms and to cause them to enter into the domain of painting. In fact, for example, if one pretends to model an arcade in stone by tones, admitting that he can produce some illusions at one point, it is certain that in looking obliquely at this deception, not only is the illusion impossible, but those surfaces that have no projections, those mouldings and profiles that do not submit to the laws of perspective, produce the most d disagreeable effect. The deception in this case is a puerile satisfaction that the painter gives himself, considering the object that he wishes to render from one point; it does not form a decorative painting, but only a trick of skill. Beautiful antiquity and the middle ages never understood that fashion of decorative painting. If the painters of the 13 th cen-

century desired to decorate a substructure, that the architect had not actually produced, they interpreted the architectsral forms in this manner (Fig. 15).[1] By the aid of flat coats of yellow ochre and of designs in brownish red on a white ground, they obtained a very rich decoration, very easy to execute, not expensive, and that in reality produced an effect much more decorative than could be done by a painting in illusion. Here the tympanums within the arches, the suspended fabrics, as well as the band J are laid in yellow ochre; all the rest of the arcade as well as the outlines of the borders of the fabrics, the ornaments of the tympanums, are in brownish red; the ground is milky white. Such simple procedures, that can be employed by the most ordinary workmen, explain why painting w was also applied indeed to modest edifices, as well as to ch chapels and sumptuous halls. Assume the ground of this arcade to be an intense blue on light green with damascening in gold, and we shall have a substructure of extreme richness, that h however will present no difficulty in execution. In the modest as in the sumptuous painting, we shall have an equal amount of art; in truth that is worth more than painted marbles,and the coarse and barbaric appearance of richness that is generally sought in decorative painting, by endeavoring and indeed never succeeding to deceive the spectator as to the actual v value of the object decorated. We have retained some remains of those good traditions in our wall papers. Thus they sell throughout the entire world as works of art.

Note 1.p.96. Traces of a pointed arcade, abbey of Fontifroide.

We have already seen that strongly colored glass has imposed a great variety and a great intensity of tones in mural painting, as well as the support of gold. But reasons of economy do not always permit the resolute adoption of this complicated harmony, that can only be obtained with extensive resources. It is interesting to see how the artists have got out of the difficulty in such cases by neither employing gold nor consequently blue, and limiting themselves to a simple harmony, t that comprises only red, yellow, white, black and some intermediates, like gray and green.

The choir of the church S. Nazaire of Carcassonne, the old cathedral, is an actual lantern filled with glass of incompar-

incomparable brilliancy and richness of tone. To sustain the translucent coloring of this glass, men thought that they must paint this choir, but probably the resources were vern small, and they aimed at economy. Not being able to use gold, the p painters have not adopted blue; they contented themselves with a simple harmony, and here is how they proceeded. The glass forming the entire surface of the walls, there remained for painting only the arcade of the substructure, the piers and the vaults. Fig. 16 giving the horizontal projection of that vault, the angle A was reserved for drawing there one subject; Christ in his glory; all the other triangles have been divided at the bosses by bands b. In the four half triangles c were drawn figures of angels on white grounds with red stars. As for the other grounds of the vaults, they have been alternately coated with white and with red ochre, as indicated by the drawing, the letter B marking the white grounds and R the red grounds. It will be agreed that this was bold. To sustain the value of those tones placed under the vaults, not only have these been intersected by the bands and bosses, but they have been bordered by ornaments in very vivid tones and very detailed. The ribs have been also covered by delicate and very v vivacious ornaments. Here (Fig. 17) is a detail of the part of the vault occupied by Christ. The divine personage is clothed in a purple robe approaching violet, with a facing of light green; his halo alone is of gold; so the second halo a painted behind his shoulders is blue. It is the only blue touch of the entire vault. The ground of Christ is vivid red, t the animals are in grisaille, as well as the outer halo. The ground of the seraphim is brownish red. The two angels and t the two seraphim are in grisaille with yellow wings. As for t the ground F of the other great angles, it is white with red stars, as we have stated. These are clothed in yellow, with wings in grisaille. Fig. 18 gives the details of the painting of these vaults. At A is the transverse arch, traced at A′ in Fig. 17. The fillet b is painted with squares alternately vermilion and brownish red bordered with broad black lines, with half squares of yellow ochre. The hollow c is brownish red. The round d is ornamented by a rope alternately black, yellow ochre and brownish red, each tone being separated by a white line. The hollow d′ is brownish red. The second fillet is cov-

covered by little quatrefoils of yelloy ocnre and brownish red bordered by a white line, with black ground. The hollow is br brownish red. The second round has on its upper part vermilion squares bordered by white lines, the ground is yellow ochre; the hollow below it is yellow ochre. The fillet n is decorated by quatrefoils alternately brownish red and yellow ochre on a black ground bordered by white lines.

The diagonal ribs B havetheir fillet it like the fillet e. The hollow k is brownish red and the round l is spirally decorated like the round d. The hollow m has little squares of salty gray on a ground of yellow ochre with a lower white fillet. The extreme round n is covered by vermilion quatrefoils on a black ground with white fillets. The extreme fillet o is also white. At C we give one of the borders laid on the vaults beside the diagonal ribs; those borders are all nearly similar. The ground of the design is vivid brownish red; the quatrefoils are vermilion with blackish blue squares, they are outlined by a black line and a white border; the intermediate squares are yellow ochre and the little scroll is white. A broad white line borders these bands; it is doubled by another light brownish red band with slaty gray squares and black lines. One of the stars is sketched at p. These stars, which are red on the white grounds of the vaults, are white on the brownish red grounds. At D we give one of the bands from the bosses of the vaults; their coloring consists of a white ornament slightly modeled with red lines on a vermilion ground; a wide brownish red band divides them in the middle lengthwise; white bands s stop the vermilion grounds and are externally bordered by black bands. Those vaults being supported by clusters and delicate little columns, these are simply colored with alternate yellow and red tones with hollows black or red with black squares and white lines; the capitals have their leaves painted in yellow ochre on a dark brown ground. At the entrance of t the choir, half columns G of very large diameters (1.? ft.) are decorated by paintings, whose developed detail we give at G'. These are squares with four lobes alternately greenish blue and yellow ochre, on the grounds of which dark yellow o ornaments are detached on a greenish blue ground, white on yellow. The intervals t are yellow ochre with white ornaments, a fragment of which we sketch at a larger scale at S. The lo-

lobed squares are outlined by a reddish brown line and a white band. The external fillets of the half column are white, brownish red and yellow ochre. Below the windows extends a very r rich arcade [1] painted with heraldic shields on green grounds. Mitres surmount the shields. The rounds are ornamented by white, black and red squares. White and red lines border the grounds. In spite of the brilliancy of the glass, this coloring sustains itself and harmonizes perfectly with the translucent tones. These vaults with alternate white and red triangles, with their bands of brilliant tone from the bosses and their rich borders, have a very warm and solid effect. The a architectural members are strongly detached by the very fine details in which black plays an important part, and are well distinguished from the compartments, while appearing light. These paintings date from the beginning of the 14 th century, like the construction itself.

Note 1.p.101. See Art. Construction, Fig. 111, that gives a section of the entrance to this choir.

It was necessary to take a bold method, when one assumed to decorate the so-called Gothic architecture by paintings. It was necessary for this painting to allow ts dominate entirely the splendor of the colored glass, or it must sustain and participate in that brilliancy; it was particularly important t that the structural forms, that have such great importance after the 13 th century in edifices, should be clearly accented by the system of painting. If one adopted blue vaults with gold stars, for example, it was necessary for the ribs of the vaults to be brillian ly colored sufficiently to support those grounds in strong tones, and to refer them to a different plane, so to speak. Gold was a great aid on these occasions, as well as black outlining the vivid tones, like vermilion and green. The painting of ribs and vaults thus treated, it required to support this, tones not less vivid on the clusters forming the piers, since the radiation of the colors of the glass tended to weaken the coloring of those piers, often very slender. Then only by hollows of a very warm and dark t tone, like brownish red glazed with lake, very strong purple or blackish brown, that one could overcome the graying effect distributed by radiation from the glass over those adjoining surfaces. It was necessary to give to certain colors, like ve

vermilion, all their brilliancy and to spot them with contrasted touches. Thus on the little column colored vermilion were laid touches of light blue always outlined with black; or on the little column colored light blue, touches of vivid purple; on that coating of intense blue, touches of rose purple. It is also understood, that gold lent its splendor to those groups of columns devoured by the nearness of translucent colors, when blue entered as a great part of the general harmony. The arcades or diaper ornaments arranged beneath the windows, being less devoured by the glass and nearer the eye, could resume softer and lighter tones, and then the groups of little columns passed before them, detached in vigor and brilliancy. This system was perfectly understood in the painting of the S. Chapelle of the palace.[1] Indeed in the system adopted for that interior, all supporting parts that form the skeleton and ribs of the edifice, are detached with vigor and brilliancy. On the contrary, the grounds are soft and are kept in the second plane.

Note 1.p.102. When the restoration of the paintings of the S. Chapelle was commenced, there had not been discovered the system of coloring of the ground of the arcades below the windows. Numerous trials were made, all on a dark scale, but the general harmony was deranged by that and these dark grounds. In washing a wall near the entrance one day was found a fragment of the light diaper ornament, that formed the ground of this arcade; being immediately reproduced, the general harmony was reestablished.

To restrict the radiation of the colored glass, the decorative painters of the middle ages employed certain means for an assured effect. If these windows had splays, for example at the beginning of the 13 th century, these were decorated by ornaments very strongly accented by the difference in tones. These designs were black and white, like that presented at A in Fig. 19, or reddish brown, black and white, like that sketched at B. Those strong colors, weakened by the effect of the decomposed light passing through the colored glass, retained sufficient vigor and distinctness to border the translucent paintings, and assumed harmonious tones by the radiation from those paintings. If the windows, like most of those seen in the edifices of the middle of the 13 th century, consisted of

mullions forming slight groups of little columns, those were covered by tones very near black, such as dark brownish red, very intense greenish blue, dark slate,or brownish purple. Those obscure lines formed a frame for the glass; yet the c colored glass being always bordered by a narrow band of white glass as a margin, and to prevent the wavering of the translucent tones against the architecture, along that white band was painted a vermilion line to better accent the brilliancy of the luminous line. (Art. Vitrail).

Independently of the coloring and of the harmonic system of decorative painting, the artists of the 12 th and 13 th centuries notably gave to the designs of painted ornaments forms suited to the place occupied in the architecture. Indeed the design of an ornament applied on a surface sensibly modified that, as we briefly indicated in Fig. 6. The bands are covered by ornaments running horizontally. The piers and columns, the vertical surfaces, that support and therefore must appear rigid, have their surfaces occupied by ascending ornaments.

Here are some examples (Fig. 20) of ornaments borrowed from paintings covering columns of the 12 th and 13 th centuries. Example A comes from the columns of the apsidal chapels of S. Denis. It presents a spiral of light green on a ground of whitish yellow, bordered by a brownish red stripe, with white dots set on the red and green.[1] Examples B come from columns of the church of Romans. That at B gives a lattice of red leaves on a greenish blue ground; B a has greenish blue lozenges with brownish red designs on a white ground; B b has dark brown and green vairs on white; B c has green and red chevrons on a white ground, with an interposed brown stripe. Design C was drawn on the shaft op a column of the church of S. George of Boscherville, and has chevrons of red lake and vivid green on white ground, with an interposed stripe of vivid brownish red.[1] Example D was very common in the 13 th century, and gives the columns delicacy and rigidity. The breaks in the vertical lines have the advantage of making felt the cylindrical surface of the column, always destroyed by flutes, especially if these columns are slender. This need of conforming the painted ornament to the construction, and for even strengthening that by the kind of painting, caused the adoption of those jo jointings so common in especially the colored decoration of the 12 th and 13 th centuries. Those jointings are very simple

or rich is shown by Fig. 21, white on a yellow ochre ground, or more frequently brownish red on a white or a pale yellow ground; the lines thus traced with the brush on large surfaces, single, double or triple, or accompanied by certain ornaments, present very economical decoration, perfectly accenting the bands, groups of columns, and borders covered by a more complex ornamentation and with brilliant colors.

Note 1.p.103. These ornaments of columns are shown developed.

Note 1.p.104. These examples of columns belong to the 12 th century.

In interiors, when the walls and piers are painted, sculpture is naturally covered by colors; for it is to be noted that the artists of the middle ages, like those of antiquity, did not admit partial coloring; indeed they either did not paint interiors, or they entirely painted them. If they had small resources at command, this painting was merely whitewash on a great part of the surface; but they thought that the painting called for painting, and that a colored band could not be placed alone on a wall retaining its stone color. That is a very proper feeling for harmony. If there be sometimes exceptions to this rule, this is when the painting is only regarded as an outlining of the form. For example, certain sculptures of capitals and reliefs are seen, whose ornaments and figures are outlined in black or brownish red; certain hollows of ribs or of groups of little columns are filled with a brown tone to trace the form; but that is no longer painting but drawing, a means of accenting forms, that one desires to make better seen. Also sometimes, as for example in the vaults of the choir of the cathedral of Meaux, men had the idea of distinguishing the voussoirs of diagonal or transverse arches by means of two different tones. These are exceptions. In Art. Statuaire, we shall speak of the mode of coloring images and statues, f for the artists of the middle ages have most frequently admitted, like the Greeks of antiquity, that statues should be colored. As for the ornamental sculpture of interiors, kept in l light tones on dark grounds during the Romanesque epoch of the 12 th century, light green or yellow ochre on grounds of brown, purple or even black, it is colored more strongly during the 13 th century, and particularly during the 14 th, in order to detach it vigorously from the simple parts, according

to the systems that we have mentioned above. If gold appeared in the decoration, the foliage of the capitals is gilded entirely or in part on grounds of purple, blue or vermilion. If gold is excluded, the ornaments are covered by yellow or vivid green tones on very vigorous grounds, and the yellow is outlined by black lines like gold; for gilding is never laid without being accompanied by detpths and red undercoats, with black outlines, so as to clear and illuminate the forms of t the sculpture. Those black lines are brilliant, being laid w with a material like our varnish, and always have a brown gleam. In this way the gilding assumes a brilliancy and marvellous relief, it is never soft or undecided. If the gilding be placed on large surfaces, as on grounds or as draperies of s statues, network and glazing give a precious and light effect to its gleam; thus one prevents those reflections, so crushing for the adjacent coloring, too broad lights and too uniformly brilliant.

Let us close this survey of painted decoration of interiors by a general remark on the system adopted by the artists of t the middle ages. Everyone has seen Persian rugs, Indian shawls, and all are struck by the soft and substantial splendor of those fabrics and their incomparable harmony. Well! Let o one examine the procedure of coloring adopted by those oriental weavers. The procedure is at bottom very simple. Setting aside the choice of tones, that is always soft and delicate, we shall see that of ten tones eight are broken, and that the value of each one results from the juxtaposition of another tone. Unravel an Indian shawl and separate the tones, and you will be surprised by the little brilliancy of each one taken separately. Not one of those balls of wool, that does not appear dull in comparison with our dyes, and yet when they have passed through the loom of the Thibetan and have become fabrics, they excel all our fabrics in harmonic value. Now that quality consists solely in the knowledge of the relation of tones, in their proper distribution, because of their influence on each other, and particularly in the relative importance given to broken tones. Indeed it is not necessary for obtaining a painting with brilliant appearance, to multiply pure c colors and to make them scream beside each other, but to give a special value to a point by neutral surroundings. A square

of 0.4 inch of turquoise blue on a large reddish brown surface will acquire value and delicacy, so that at ten paces this t touch will appear blue and transparent. Enlarge this area five times, and it will not only seem dull and boubtful, but it w will make the warm brown tone surrounding it heavy and cold. There is then a science there, an experimental science, it is true, but our decorators marvellously possessed during the m middle ages, as proved in the painting of their monuments, t their vignettes of mansucripts and stained glass; for those laws, already imperious in monumental coloring, are quite more tyrannical already in the translucent coloring of glass, where every touch of color assumes such great importance.

The procedures employed by painters for decorating interiors were already very perfect in the 13 th century, as can be judged by examining the old paintings of the S. Chapelle and those of certain reredoses of the same epoch.[1] Then varnish and oil painting were in use. In the 14 th century it even appears that frequent use was made of the last process in France, Italy and Germany.[2] M. Emeric David in his Discours historique sur la peinture moderne,[3] demonstrates in an evident manner, that from the 11 th century, the painters used colors ground with pure linseed oil, and the list of painting executed by order of the duke of Normandy (later Charles V) in the castle of Vaudreuil in 1355 by Jehan Coste, proves that the process of painting in oil was then known in France, and was practised not only for furniture and small works, but also for the decoration on the walls. This list begins thus:--

1.p.107. Among others, the reredos deposited in the south side aisle of the choir of the abbey church of Westminster. (Work of the French school).

Note 2.p.107. See Cennino Cennini, already cited, and the description of the painting mode in Vols. I and III of the second series of the Bibl. de l'ecole de Chartres. p. 544,335.

Note 3.p.107. Paris. 1812. 8vo.

"First for the hall in the manner in which it is commenced or better; i.e., to complete the story of the life of Cesar, and below on the lowest band a list of beasts and images, just as commenced.

Item, the great chapel, to make the stories of Our Lady, of S. Anne, and of the Passion around the altar, as it can be ma

made, etc.

And all those things described will be done with fine colors in oil, and the grounds of fine gold in relief, etc."

Glazing was frequently employed in decorative painting after the 13 th century; the delecacy of these paintings, their solidity and brilliant appearance, indicate a procedure permitting all the refinements of modeling and coloring. With oil painting, the artists of the 14 th and 15 th centuries in France, also employed a painting into which enters as adhesive a very hard anf very transparent resinous material, for example like gum copal. Perhaps the two elements, oil and resin, were employed together, gum copal then taking the place of a dryer. Analysis of some of these paintings indeed often shows a certain quantity of resin.

Decorative painting is not only applied to the surfaces of interiors, but it plays an important part on the exteriors of edifices. The facade of Notre Dame of Paris presents numerous traces of painting and gilding, not laid on the bare walls, but on mouldings, columns, ornamental sculptures and statuary. One can make the same observation on the cathedral of Amiens, and the ornaments placed at the tops of the great gables of the transepts of the cathedral of Paris, which date from 1257, were gilded with dark and black grounds.

The coloring applied on the exterior is much harder than t that of the interior; these are tones of vivid red (vermilion glazed with a very brilliant purple tone), hard green tones, orange yellow ochre, pure blacks and whites, rarely blues. Indeed on the exterior the strong direct lights and shadows permit a hardness of coloring, that would not be supportable under the diffused and softened light of the interiors.

Statuary according to the antique method is outlined by blackish brown lines, that accent the lines of the head, and b borders of the drapery, embroideries, and the folds of the g garments. The ornaments are likewise very strongly outlined by these black lines, either on the grounds or on the edges. Sometimes under the projections of drips, bands or cornices, t the rounds are covered by a red or green tone and are enhanced by white or yellow dots, that give a singular delicacy to the mouldings. We have become so timid in the matter of monumental painting, that we scarcely understand today that expression of

art. It is with painting applied to architecture as for a musical composition, that to be understood it must be heard several times. And if twenty years since, no person in Paris could understand a symphony of Beethoven, one could not blame Beethoven for it. Harmony is a language for the eyes as for the ears; one must familiarize himself wit it to seize its sense. Some enlightened persons voluntarily admit that the i interiors of edifices may well be decorated by paintings; but the idea of decorating the exteriors seems very strange, particularly if it be necessary to decorate them, by some tympanums under porches, but by the entirety of coloring, that extends over nearly the entire facade.

Yet the artists of the middle ages never had the idea of entirely covering with color a facade 230 ft. high by 164 ft. wide, like that of Notre Dame of Paris. But on those immense surfaces they adopted a system of decoration. Thus at Notre Dame of paris the three portals with their voussoirs and tympanums were entirely painted and decorated; the four niches connecting those portals and containing four colossal statues were likewise painted. The gallery of kings alone formed a d deep band entirely painted and gilded. The painting above that band was only attached to the two great arches with windows beneath the towers, and to the central rose window, which sparkled with gilding. The upper portion being lost in the atmosphere was left in the tone of the stone. Examining this facade, it is easy to render an account of the splendid effect, that must have been produced by this system so well in accord with the architectural composition. In that coloring black p played an important part; it bordered the mouldings, filled the grounds, outlined the ornaments and accented the figures by broad lines placed with a true feeling for the form. Black intervenes there as a retouch of the master, to remove its c coldness and dryness; it frequently merely doubled a wide orownish red line. The roofs were brilliant with colors, either by the combination of glazed tiles, or by painting and gilding applied on the lead. (Art. Plomberie). Sometimes even plates of glass were set in grounds on cement, interposing a leaf of tin or gold, adding touches of very vivid brightness in the midst of dull tones. Why do we deprive ourselves of all these resources supplied by art? Who does the so-called classical

school pretend that coldness and monotony are companions inseparable from beauty, when the Greeks, that are presented to us as preeminent artists, always colored their edifices inside as well as outside, not timidly, but with the aid of colors extremely vivid?

After the 16 th century was renounced the external painting of architecture, and gradually coloring disappeared; yet at the beginning of the 17 th century men sought colored effects by the aid of a combination of brick and stone, sometimes even with applied faience.

PENDENTIF. Pendentive.

A triangle of a hemispherical vault left between the penetrations into this vault by two round or pointed half cylinders. The earliest pendentives mentioned in the architecture of the middle ages in France are those supporting the domes of the a abbey church of S. Front at Periqueux (Art. Coupole, Fig. 6). This system of construction has rarely been employed except in localities near that important monument. But by extension, t the name of pendentive has been given to trumpets or corbellings placed in the angles formed by arches resting on a square plan, and intended to cause the construction to pass from the square to the octagonal or the circular plan.

Taking the term pendentive in the last sense, we shall have in many provinces of France domes and transept towers resting on pendentives. Thus for example, the central lantern of the church of Nantua would be borne on pendentives (Fig. 1). In fact the triangle A is only a corbelling whose horizontal section is straight and not curved, as must be every horizontal section of a pendentive. The courses composing this corbelling have horizontal beds and do not tend to the centre of a sphere, as the beds of a pendentive should do.

To restore the true meaning of the word pendentive, we present in Fig. 2 a sort of analysis of the system of construction to which it should be applied. Take a hemisphere whose horizontal projection is the dotted line A B C D. On each side of the square A B C D inscribed in the sphere, if we erect vertical planes, we form four sections A B a, B C b, C D c and D A d in the hemisphere, that give semicircles. Assume that we

turn four arches under these four semicircles, we shall then transfer the weight of the upper calotte of this sphere and the four triangles to the four points A B C D. Then admitting that above the crowns of these four arches we make a horizontal section in the hemisphere, we shall obtain a perfect circle a b c d. On this circle we erect a hemispherical vault a b c d e, and we shall have a dome borne on four actual pendentives. The beds of all voussoirs forming these pendentives, (that are only fragments of a primary dome) will radiate from the centre E, just as all beds of the voussoirs of the upper dome a b c d e will radiate from the centre g. Thus the entirety forms a homogeneous shell, whose weight tends to press the voussoirs of the interior and are entirely transferred to the four points A B C D. This system of vaulting, employed first in the great church of S. Sophia of Constantinople,[1] as we have stated, was applied to the construction of the church of S. Mark of Venice, then to that of the church of S. Front of Perigueux about the end of the 10 th century. Still the constructors of Perigord manifested timidity in the use of the means, that makes one credit their small confidence in the efficiacy of this system, and especially their c complete ignorance of the theory of the pendentive; while at S. Mark of Venice the domes and their pendentives are drawn and built according to the theoretical principle that governs this kind of structure. At S. Mark the generating curve of t the pendentives of the dome is the complete semicircle; it is not the same at S. Front of Perigueux, and we shall see what were the singular consequences of the modification made by t the French architects in the principle adopted at S. Mark. Fig. 3 gives at A the horizontal projection of one of the domes of S. Front. The four piers that support the transverse arches receiving th pendentives are at B. Perhaps frightened by the overhang that would form the four pendentives, if they were generated by a semicircle, the architect of S. Front had the idea of generating these pendentives by means of a pointed curve a b c (see section C). Hence erecting vertical planes f from the angles of the four piers to form the penetrations of the transverse arches in the generating form of the pendentives, he could not obtain semicircles, but an elliptical curve traced in e f g. The ellipse presenting difficulties in joint-

jointing, the architect cheated and replaced the elliptical curve by a pointed arch e f c′. A fact unheard of at that epoch, that all other arches are round. This architect, instead of erecting a dome vertically on the pendentives at h, caused it to recede to l, and thus gave it a less pointed curve l m, as shown by the section. So that the section made on the diagonal n o gives the trace D. It must be stated that these pendentives, instead of being constructed of voussoirs with beds radiating from the centre n, are formed of large blocks of r rubble set horizontally and corbelled, as seen at p. The pendentives are then only a sham, not a principle of construction understood and applied. This fact alone seems to indicate that if the church of S. Front was erected in imitation of t that of S. Mark, as perfectly demonstrated by M. Felix de Verneilh,[1] the construction was entrusted to some western architect, who not obtaining an accurate knowledge of the system of domes on pendentives (since these pendentives are after all only corbellings), and consequently sought to lessen their o overhang by not erecting these domes vertically over the upper section of these pendentives. Later our western architects, better informed or wiser, erected actual domes on pendentives, as proved by the churches of Angouleme, Solignac, Cahors, Souillac, etc. Yet one will observe that the generating curve adopted for the pendentives of S. Front will remain sanctioned, for the transverse arches of those churches all give pointed curves, although in those provinces the round arch long continued in honor. (Arts. Architecture Religieuse, Construction, Coupole).

Note 1.p.110. S. Sophia of Constantinople at least presents the first known example of this kind of vault.

Note 1.p.113. L'Architecture Byzantine en France. 1851.

PENETRATION. Penetration.

A word employed in architecture to designate the points of intersection of two bodies or of two forms. Thus for example in Fig. 139 (Art. Construction), the openings of the domes of the great hall of the castle of Coucy form penetrations in the ceiled vault. In Romanesque architecture are sometimes seen windows causing penetrations in masonry vaults. Some tunnel vaults of the Romanesque epoch also receive penetrations of

vaults. Hence these cases are extremely rare. Here (Fig. 1) is an example taken from the abbey church of Fontgombaud (12 th century). It is surprising that having recognized the danger of tunnel vaults, that the architects of the 12 th century did not more frequently employ the system of penetrations, which had the advantage of transferring these thrusts to certain points, more stable or abutted. In the church of Fontgombaud, the arches of the vaults are round. This penetration alone, although of the same epoch, presents a pointed curve; it had been built in the first bay of the transept, to permit t the opening of an exceptional upper window. One sees windows in penetration in the vault of the nave of the little church of Chateauneuf.

The name of penetration is also given to those vertical prismatic forms, that in the architecture of the 15 th century, pass through bands and are found at different heights. (Art. Trait).

PENTURE. Hinge.

A piece of ironwork employed for hanging the leaves of doors. (Art. Serrurerie).

PERRON. A flight of external steps.

During the middle ages the word "perron" is commonly employed to designate the external steps that give admission to the principal hall of the castle or palace, in the place reserved for hearing or great assemblages.

In the Chanson des Saxons,[1] the barons brought to Charlemagne four deniers apiece. The emperor caused the sum to be laid in a heap. (Old French poem).[2]

Note 1.p.115. Chanson des Saxons, by Jean Bodel, a poet of Artois, of the 13 th century.

Note 2.p.115. Chapter 45.

The great flight of steps is one of those traditions of the peoples of the North, whose origin runs very far back in the historical annals. It is the platform of the Scythians, the pile of stones on which sat the chief of the tribe; the emblem of the high place on which were, and from which descended the conquering and superior races. It would be interesting to investigate and collect the origins of the platform placed on a flight of steps, for that is one of the monuments that one f

finds on the surface of the globe, wherever a superior race has established itself in the midst of conquered peoples. From the top of the flight of steps the Roman general addressed the troops under his orders. The campaign tribune on which s sat the general to receive the submission of the vanquished, was only a pile of stones with a flight of steps.[1] On a flight of steps the author of the Chanson de Roland has his hero die, as on a sacred place. (Old French poem).[2]

Note 1.p.116. See the reliefs on the column of Trojan. (Latin quotation; De Bell Gall. Book VII. Surrender of Alesia).

Note 2.p.116. Chanson de Roland. Stanza 145.

In the romances of the 12 th and 13 th centuries is frequent mention of flights of steps at the top of which stand the lords to receive their vassals:-- (Old French poem).[3]

Note 3.p.116. Ogier l'Ardenois. Verse 8517.

To the bottom of the flight of steps of the palace descend the personages that come to visit the superior; they are received there, if it is desired to do them honor. (Old French p poem).[4]

Note 4.p.116. Romans de Berte ous grans pies. Chap. 9.

When William of Orange surrendered to the king of France a after the fall of Orange, he arrived incognito. (Old French poem).[5]

Note 5.p.116. Guillaume d'Orange, la bataille d'Aleschans, Verse 2568 et seq.

The steps of castles were accompanied by horse-blocks.(Art. Montoir):-- (Old French poem).[6, 7]

Note 6.p.116. Chanson des Saxons. Chap. 22.

Note 7.p.116. Le Lai of Laval; poems of Marie of France.

As we have already seen above, the flight of steps is sometimes a monument destined to perpetuate a victory. Such is t that which Charlemagne caused to be erected at Tremoigne:- (Old French poem).[1]

Note 1.p.117. Chanson des Saxons. Chap. 298.

The flight of steps was then a mark of nobility, a sign of power and of jurisdiction. The communes erected flights of steps before their city halls as a sign of their franchises; thus we see that when Charles, Duke of Burgundy, had subjugated the territory of the city of Liege in 1467, to punish the citizens for their revolt, and to mark their humiliation:-

(Old French poem).[2]

Note 2.p.117. Chants populaires of the time of Charles VII and of Louis XI, published by M. Le Roux (de Lincy). Aubry. 1857.

This passage explains all the importance attached to the flight of steps during the middle ages, and why these external steps were regarded as the visible mark of the power of t the lord. Lord de Joinville relates that going to the palace one day, he met a wagon laden with three dead men being taken to the king. A cleric had killed these three men, who were e sergeants of the Chatelet, and had robbed them of their clothing. Leaving his chapel, the king "went to the flight of steps to see the dead, and asked the provost of Paris how this had occurred." The case being explained, and the cleric having acted bravely in a case of legitimate defense: -- "Sir cleric," said the king after hearing the report, "you have lost becoming a priest by your prowess, and by your prowess I retain you in my service, and come with me over the sea. And for what you have done, I much desire that my men may see, that I will not sustain them in any of their bad deeds."[3]

Note 3.p.117. Memoires of Lord de Joinville. Section 84.

Here then is a judgment rendered by the sovereign in the oo-open air at the top of the flight of steps of his palace.

These flights of steps, even by the importance that they a assumed in the palaces and castles, were richly built, decorated by balustrades and by sculptured figures. Some lords, according to a custom that seems very old, even fastened wild animals to the foot of the flight, as if to prevent approach. A tale in verse of the 13 th century relates,[1] that a certain castellan of the city of Rome, a wealthy and powerful man, had fastened a bear to the steps of his palace. At the top of the flight of steps of the castle of Coucy, at the entrance of the great hall, was a slab bearing a stone lion, supported by four other lions.[2]

Note 1.p.118. Le chien et le serpent. (See Legrand d'Aussy).

Note 2.p.118. Some fragments of this monument still exist. They have been deposited in the keep.

We shall be pardoned the length of these quotations; they were necessary to explain the importance of the flights of s steps during the middle ages. We shall now examine some of

those monumentr. One of the most remarkable, although not of a very early period, was the flight of steps built before the wing that connected the S. Chapelle of the palace at Paris with the great hall. This flight dated from the reign of Philip the Fair, and was erected by the care of Enguerrand of Marigny. At the accession of Louis the Obstinate, Enguerrand having been condemned to the gibbet, his statue was "cast down from the top to the bottom of the great steps of the palace."[3] It was only about the end of the last (18 th) century, that the great flight of steps of the palace was destriyed, to be replaced by the existing flight (Art. Palais, Fig. 1). Before that flight and a little to the left was planted the maypole. We give a perspective of the flight of steps built at the beginning of the 14 th century.[4] When it was destroyed, booths encumbered its two side walls and were attached to the beautiful gallery of Enguerrand; but the portal seen in our Figure remains almost entire with its three statues. A vault constructed under the great platform permitted passage from one side to the other of the court. The flight of steps of the palace of the counts of Champagne at Troyes presented a similar arrangement, and dated from the beginning of the 13 th century. It opened directly at one side of the great hall. At some yards in front of the bottom of the steps was placed a block on which the hands of criminals were struck off, after the sentence had been read to them, that condemned them to capital punishment.[5] Sometimes these flights of steps were entirely or partly covered, like that of the castle of Montargis, (Art. Escalier, Fig. 2), which dated from the 13 th century, and was divided into three flights surrounded by roofs of c carpentry.

Note 3.p.118. Antiquities de Paris. Corrozet.

Note 4.p.118. Restored by the aid of old plans of the palace and two drawings of the collection Lassus, that have been lithographed in fac-simile to form a part of a monograph.

Note 5.p.118. See Voyage archaeologique dans le departement de l'Aube, by Arnoud. Troyes. 1837.

The castle of Pierrefonds possessed a remarkable flight of steps at the base of the stairway of honor, with two horse-blocks for riders, and a cross vault with a terrace above. We give (Fig. 2) the plan of that flight. The stairway B led to

the great halls of the keep situated at A; it ended next the court,[1] on three flights. The two horse-blocks are at C; three cross vaults cover the steps. A view of this flight of steps taken from the point P (Fig. 3) will relieve us from entering into more ample details. Few arrangements adopted in the construction of castles of the middle ages will be perpetuated longer, since we have also retained it in our days.

Note 1.p.119. See the plan added to Notice sur le chateau de Pierrefonds, by Viollet-le-Duc. 3 rd edition.

The grand stairway for horses of the chateau of Fontainebleau, whose construction is attributed to Philibert de l'Orme, is a tradition of the middle ages. That of the chateau of Chantilly forms a loggia with two lateral flights and dates from the 16 th century.[1]

Note 1.p.121. See Du Cerceau, Les plus excellents bastiments de France.

The flight of steps was a sign of jurisdiction, and the provosts rendered justice in the open air from the top of their flight;[2] also the city halls usually had a flight of steps, a and the removal of that flight occurred, when it was desired to punish a city for rebellion against its sovereign, as we have seen above in relation to the insurrection of the men of Liege.

Note 2.See the account of the sacristan. (Legrand d'Aussy).

PIERRE (a batir). Stone for building.

The Romans were most intelligent exploiters of quarries that ever existed. The stone structures that they left were always built with the best material to be procured in the vicinity of their monuments. There exists no Roman monument of which the stone is of mediocre quality. When such was absolutely l lacking in an extended radius, they employed bricks, rather than place in the work building stones of inferior quality; and if one desires to have good cut stone in a country where the Romans erected monuments, it is only necessary to seek t the Roman quarries. This rule has often been of great assistance, when we have had to build in localities, in which the custom of using cut stone had been abandoned for a long time. Even on lands rich in materials suitable for construction, it is interesting to observe how the Roman builders knew how to

exploit with rare sagacity the best places, however difficult was the quarrying. This fact can be observed in Provence, Languedoc, in the country of the Edui (vicinity of Autun), Bordelais and Saintonge, and on the coasts of the Mediterranean. F For example, one sees on the Roman road from Nice to Mentone, at a paint where is found a monument known by the name of the Turbie, a Roman quarry remaining untouched since the epoch at which was erected that edifice. That quarry is in the midst of limestone mountains, located on an almost inaccessible precipice above the little city of Monaco; indeed there is found on that point a thick bed of limestone of very superior quality. These traditions were preserved during the middle ages; men knew the good quarries, and the stone employed was generally chosen with care. There is no country in Europe, that supplies a quantity of stones for building so varied and as good as France.

If one glances at the geological map of France, he will observe that from Mezieres in ascending the Meuse and going southwest by Chaumont, Chatillon-sur-Seine, Clomecy, Charite, Nevers, Chatre, Poitiers and Niort, then descending southeast by Ruffec, Nontron, Exideuil, Souillac, Figeac, Villefranche, Mende, Millaud, then ascending by Andure, Alais, Largoutiere and Privas, he follows an unbroken chain of Jurassic limestone, that he will find again after crossing the Rhone by ascending the Ain from Belley to Salins, and the Doubs from Pontarlier to the limit of the Black Forest. Toward the North from Sable to the mouth of the Orne extends a branch of that chain, which seems to be arranged to distribute over all provinces of France the materials most favorable to construction. In t the five great divisions formed by that chain, one finds in t the first at the North chalk at Troyes, Arcis, Chalons-sur-Seine and Rheims; coarse limestones in the basins of the Seine, Oise, Aisne and Marne, with sandstone toward the West; on the other side of the Jurassic branch directed toward the Channel are granite and coarse limestones; in the third on the left bank of the Garonne are the green saudstones and the saudstone of Fontainebleau to the foot of the Pyrenees; in the fourth at the centre are granites and crystallized earths; finally in the fifth, which comprises the lower basin of the Rhone, are sandstone and Alpine limestone. Let us add to this collec-

collection the volcanic earths with lavas and basalts at the centre, and we shall have a survey of the wealth possessed by France in materials suitable for building.

Until the end of the 12 th century, constructors evidently recoiled from the use of materials of great hardness, like granite; they sought stone of medium hardness and used it in small blocks, as far as possible; and such is the distribution of the lands on the surface of France, that it was necessary to go very far to seek limestone, chalk or soft sandstone, except in some provinces like Brittany, on the upper Garonne, and at the Centre near Gueret and Aubusson. Monastic establishments exploited the quarries with skill and care; the mother house of Cluny was established in Jurassic country, as well as that of Clairvaux, and seemed to impose on their daughters the obligation to found themselves in the vicinity of rich o quarries. Indeed, we see that the greatest part of the monasteries dependant on these two abbeys are built in France on that Jurassic chain, that divides the territory into five parts, and that the architecture of the two orders, and particularly that of Cluny, robust and on a great scale, received a marked influence from the use of the materials, while in countries in which building stones are thin, low and soft, as in the basins of the Seine and Oise, for example, we see that Romanesque architecture is impressed by the nature itself of t the building material employed.

When Gothic architecture was adopted, it knew how to derive a marvellous system from the different materials furnished by the ground. From the 12 th century were simultaneously employed stones of very different qualities according to the need, as it is easy to perceive in reading our Art. Construction. Then men did not recoil before difficulties in transportation, that must be considerable when it was necessary to procure c certain stones, whose quality was proper for a special object. Thus for example, we see employed for the monolithic columns of the choir of Vezelay, built about 11?0, hard stones from Contarnoux, whose quarry is 13.5 miles from the abbey, although there was stone suitable for construction at a small distance; that at Semur-in-Auxois we see in the work that admirable stone of Pouilleray, which receives a polish; that at Sens men brought stone from Paris to build the hall of the s

synod; that at Troyes at the end of the 13 th century we see the constructors seek lias at Tonnerre and buildthe church of S. Urbain, which it would have been impossible to erect with other materials; that much later at Paris we see the architects demand stone from Vernon for restoring the rose window of S. Chapelle, and to erect certain parts of the mansion de la Tremoille. These examples, which we could multiply infinitely, prove how the constructors of the Gothic period devoted scrupulous attention to the choice of the stones, that they placed in the work. When the Gothic style was definitely accepted o over the entire surface of France about the end of the 13 th century, the constructors did not hesitate in conforming to the taste of the time, to employ stones that certainly by t their nature scarcely lent themselves to receive those forms. Thus about 1270 in the choir of the cathedral of Limoges was built of granite, that of the cathedral of Clermont of lava from Volvic; and about the middle of the 15 th century, the chevet of the abbey church of Mt. S. Michel-en-Mer was likewise of granite, without being occupied by the difficulties i in cutting presented by that material; that at the beginning of the 15 th century was constructed of very hard sandstone the sanctuary and transepts of the old cathedral of Carcassonne (S. Nizaire).

On inspection of the monuments erected during the middle ages, it is easy to recognize that then, even more than during the Gallo-Roman period, men worked a considerable number of quarries since abandoned, that they knew how to use the quarried stones according to their quality, but with scrupulous economy; i.e., that for example there was not placed in a facing stone of superior quality suitable for making monolithic columns, cornices, gutters or tracery. This fact is remarkable in one of our edifices built with a luxury of exceptional materials; we speak of the cathedral of Paris. There the constructors have proceeded with as much care as economy in the use of the materials. The stones employed in the cathedral of Paris all came from the rich quarries, that formerly existed under the hill of S. Jacques, and that extend beneath the plain of Montrouge to Bagneux and Arcueil.

The facade is entirely constructed in rock of the high bed for the faces, in soft lias for the great sculptures (a layer

having up to 3.0 ft. thickness), and in gypsum for the drips, cornices and little columns,(bed 1.5 ft. thick at most). The soft lias from the quarries of S. Jacques behaves well when set on edge, so that with this stone was made the open arcade of the great gallery betow the towers. Gypsum has given an in incomparable material for the rose window and for the longer columns of the gallery, as well as for all the drips of the terraces. Among these materials, one also meets in the surfaces and for the caps of the battlements of the towers the old royal bed of Bagneux, that is 2.3 ft. thick, and the great b bed of Montrouge, that is 2.1 ft.; these last stones are admirably preserved. In the foundations we have recognized the use of the soft stone of the plain, and particularly of that kind termed firm, that runs to 3.3 ft. thick; sometimes the green bed, though rarely.

The great internal columns of the nave, that are 4.3 ft. d diameter, are built of courses of the low rock of Bagneux or of S. Jacques, which easily averages 1.6 ft. But the two piers of rectangular section that terminate the nave at the transverse aisle, which piers have a section relatively weak, are e entirely erected in beautiful courses of gypsum from Montrouge, which is 1.3 ft. The transverse arches, archivolts and diagonal arches of the vaults are generally of the free bed of the white bed of Montrouge, which runs from 1.0 to 1.15 ft. Thus the constructors have employed the stone, always retaining t the height of the quarry layer, contenting themselves with always entirely removing the crust or clayey defects, but without cutting with the sandstone saw.[1] Further, they set these materials on their quarry beds, when they did not adopt the s system of frankly setting them on edge as shores (Art. Construction), setting the bottom bed below. This precaution is p particularly observed in the foundation courses.

Note 1.p.124. Then the saw for sandstone was not used, and there are a good number of departments in France, in which it is not yet employed. Those are where building is best done,(it is necessary to state).

As we have stated, the Romanesque construction especially s sought soft stones, stone of the plain, from the vicinity of Paris, the free beds. The choir of Maurice de Sully, except the piers anf little columns, is entirely built of materials

of mediocre hardness, low and small. But from the beginning of the 13 th century, the new lay school on the contrary sought very firm and large materials. Then in the construction of the cathedral of Chartres was employed that limestone of B Berchere, of such a rude appearance but so solid, and that g gives blocks 3.3 ft. high with lengths of 9.8 to 13.1 ft.; that at the cathedral of Rheims were set those courses 3.9 ft. high and which cannot be found today in the quarries that supplied them, that are employed lias and the hardest gypsum, t taking care to remove the soft layers; that ar rejected as far as possible the friable beds, hollow beds without vigor.

The end of the 13 th century brought still greater care into the choice of stones. It suffices to examine the construction of th church of S. Urbain of Troyes, of the choir of Narbonne, of tn transept gables of the cathedral and palaces of Rouen, of the abbey church of S. Ouen of Rouen, of the castle of Vincennes, to recognize that the constructors knew perfectly the qualities of the limestones, and that they selected s with an attention that might serve as an example to us. In t the 15 th century men are inclined to use by preference soft stones, but still these are scrupulously chosen. In the 16 th century this important part of the art of building is too frequently neglected, the materials are not uniform, are taken by chance, and employed without taking account of their properties.

EMPLOI DES PIERRES A BATIR SUIVANT LEURS QUALITIES.

Use of Building Stones according to their qualities.

Several causes contribute to destroy the limestones suitable for construction, and causes tha act have no effect on others. Further, the combining of certain stones is injurious to some of them. The most energetic destructive principles are the s salts developed by dampness even in the interiors of stones, and the alternation of heat and cold. All stones, sandstones, even granites and limestones, contain a notable quantity of water, and absorb dampness from the atmosphere, when they dry. This property is essential to the connection of their molecules, and at the same time is the cause of their destrigtion. If the stones are placed in elevation near the ground, and t that moisture brings with it salts, that tend to crystallize by the effect of dryness of the air, forming as many little

wedge, that separates the molecules of sandstone and even of granite. These materials also contain in their sides salts, that the atmospheric moisture causes to work without ceasing. A certain stone in water or under the soil will never decompose, but changes after a year in the air. The question is then, not to deprive the stones of all moisture, but to act to preserve them, so that this moisture may act from the ou side toward the inside, and that from the exterior to the exterior; that the salts contained may always be in solution, or that they remain in the latent state. For example, assume a limestone set at B (Fig. 1) on a course of cut stone with a foundation of concrete or rubble; the effect of capillarity, i.e., because of the absorbent action of this stone, the moisture will be greatest at a, even at the heart of the stone, than at the external surface dried by the air; hence the salts will tend to come to crystallize in the direction of the arrows to these external surfaces, and will gradually disintegrate them. Assume that between this stone B of the substructure and the course C of cut stone be inserted an impermeable sheet of lead or of bitumen, the rainwater that bathes the surface will cause this surface to be more moist, even at the moment of the emission of water vapor than at the centre; further, this water will be quickly dried by the air; the salts that could be developed to come to the surface will be washed, dissolved and removed by that abundance of external water, and cannot develop crystals, or consequently remove the surfaces. In the case of complete isolation of the stone protected from dampness of the ground, the more porous it is, the more easily will i its surfaces be washed and dried, and the better will they be preserved. Resume the Fig.; assume (Fig. 2) at A, that a stone a is placed under a gutter. However compact is the stone of w which this gutter is made, it tends to absorb a certain quantity of the water that runs in its hollow. The stone a is dried by tre air and in its turn tends to take from the gutter a part of the water that has penetrated it; that water will act in the direction of the arrows, i.e., being more abundant and less rapidly dried in the heart of the stone than at its surface, it will dissolve the internal salts, which will come to crystallize on the surfaces, and will remove tese at first in dust and then in scales. But if between this gutter B and the

stone beneath be interposed an impermeable body C, that lower stone as in the preceding case will be washed on the exterior by the rain or moistened by fogs more abundantly than its heart, and the salts cannot crystallize on its surface. The stone of S. Leu, the royal bed of S. Maximin, which are preserved for centuries in free air or on surfaces are perfectly preserved from all internal dampness, fall into dust if set under gutters or cornice slabs of hard stone, that receive rainwater and absorb part of it. Although in this case the hard stone remains intact, the stone beneath is rapidly decomposed by the salts that pass through it and crystallize in i its surface; even frequently the crust of these stones has remained firm, while the decomposition is very advanced at 0.04 inch inside. For example, take (Fig. 3) a slab of hard stone A placed on a cornice B of stone from S. Leu, and one will soon see the crust of that stone rise like the scales D, showing t the profound alteration beneath the surface. Even this crust that covers certain stones contributes to hasten the work of decomposition produced by the salts, by protecting the subsurface from the contact of air. The pores being no longer so open on the external pellicle of stone, that has a thickness of 0 .04 or .02 inch, the salts crystallize under that pellicle, that they cannot traverse, and produce injuries perceived only when the crust falls off. Mouldings employed during the period of the middle ages for cornices and bands have the advantage of not retaining moisture and of transmitting it rapidly. Thus stones that cover those projections are really protected, and do not show the alterations that are observed under the cornice slabs of the Renaissance or the modern epoch. The constructors of the middle ages had so fully observed these phenomena of decomposition of stones, that they have frequently isolated gutters, either supporting them on corbels or arches, or by leaving under their beds a space void or filled by an impermeable material, such as oil cement or resin. They had no less observed the effects produced by adjacent stones on each other. Thus the sandstones, having the property of containing a great quantity of water, rapidly absorbed that of the ground and of the atmosphere. When above those courses of sandstone were placed stones that easily exuded salpetre, there was soon produced decomposition near the bed touching the sandstone, and

this decomposition never stopped, but increased each year. The stame stones being set on courses of limestone did not absorb such a great quantity of water as the sandstone, and perhaps were never decomposed. Thus when the constructors of the middle ages set courses of sandstone in a substructure surmounted by courses of limestone, they took care to choose these among the compact qualities, not sensitive to the effect of saltpetre, or indeed they inserted between the sandstone and the l-limestone a bed of slate (schist). That method was very frequently employed during the 14 th and 15 th centuries.

All limestones on leaving the quarry contain a considerable amount of water; as soon as exposed to the air, a great part of the water evaporates and comes successively to the surface. In so doing, this water carries with it a certain quantity of lime carbonate in solution, that crystallizes on the surface, forming a firm and resistant crust, that not only protects t the stone from the external agents, but gives it a patina, a covering that nothing can replace. The constructors of the m middle ages having had the custom of entirely cutting the stone on the yard before hoisting and setting, it resulted that this patina was formed on the mouldings and sculptures as well as on the faces, and that the completed edifice was uniformly covered by that crust produced by what is called quarry water. This was a double advantage; a surface better resisting atmospheric agents, a beautiful uniform and warm color given by t that natural patina. The modern custom of erecting edifices only of blocks and of cutting the facing long after the completion of the setting, removing from those materials 3/8 to 3/4 inch in thickness and sometimes more, results in destroying forever that protecting crust, since it only forms on surfaces when the stone is freshly taken from the quarry. That a modern custom is particularly injurious for the preservation of soft stones, such as the royal bed of Oise, soft stones of Paris, the limestones of Saintonge, Caen, Alpine limestones of Beaucaire, soft limestones of Burgundy, stones of Molenes, V Mailly-la-ville, Courson and Tonnerre; the chalks. But what s shall be said of that other custom of strongly scraping old surfaces? Thus from them is removed the protecting element, that has preserved them for several centuries; the stone is killed, to use an expression of the trade. Thus after that

barbarous operation, one frequently sees materials that presented no sign of change, decompose rapidly on the surface, e effloresce, then become hollowed, without being able to stop the disease that has attacked them.[1] Further, soft stones are not the only ones that are covered by a resistant patina when freshly cut. hard stones like lias,and gypsum present the same phenomena, and we have seen lias in works for five or six hundred years, that had assumed a surface scarcely to be cut with the chisel, when at 3/16 inch depth it could be scratched with the nail. Stones called cold, like those from the quarries of Chateau-Landon, for example, are the only ones that l lose nothing in being cut long after being quarried. As for sandstone, everyone knows that they can be cut only when fresh from the quarry. Certain red sandstones from the Vosges cannot be cut wit tools at the end of several years, although workable on leaving the ground.

Note 1.p.129. In this case, silicifying well done is the o only means to be used to render the stone thus coated, hard and resistant to ensure durability. Silicifying must always be employed when one has had the unfortunate idea of scraping the surfaces of monuments, and even when dressing is done after the stone has lost its quarry water.

It is always well to take one precaution when erecting edifices without cellars; this to interpose in one bed of a course above the ground a layer of impermeable material, like bitumen or fat cement, paper heavily tarred, or a bed of slates. This precaution stops the moisture rising in walls from the ground, and prevents the stones from exuding saltpetre. All the monuments of Poitou, many among those of Vendee and Saintonge, s show at about 6.6 ft. above ground on the exterior a zone greatly altered by the action of the salts. This proves the accuracy of the statement previously made, i.e., that the salts act on limestones only where they are no longer held in solution or become crystallized. Indeed, the lower courses of the walls in the monuments of those provinces, all built of soft limestone, that perfectly resists the action of the air, are saturated with dampness, but do not decompose; this only occurs at the height at which the effect of capillarity ceases, when the stone is dryer and allows the salts to crystallize, and there commences the decomposition of the external surfaces.

Masons claim that this decomposition is caused by the action of the moon, and which at first is an insignificant crumbling, then later is very deep. The fact is that this sort of decomposition is rarely manifested except in a southern exposure, slightly at the east and west, never at the north; one understands that the heat of the solar rays hastens the crystallization of the salts above the damp zone, where they are held in solution. Further, the south is the most unfavorable exposure for the preservation of materials suitable for building in France:-- 1, because in our climate the southern wind brings rain, that sweeps the surfaces, 2, because the differences of temperature are abrupt and great in that exposure in winter. At night it freezes at 46.4°F at a north exposure and at 44° at a south exposure in clear weather; but in the day, if the temperature of a north exposure remains below 32°, it frequently rises to 58.2° in the full sun. Materials more or less permeable, that suffer during some hours these differences of temperature, change more rapidly than those exposed to a nearly uniform temperature, even if very cold; but we think that the moon has nothing to do with this, unless that when full, it presents itself at the same side of the horizon as the sun.

PIGNON. Gable. Gable Wall.

A wall terminating in a triangle according to the inclination of a gable roof and forming an enclosure before the trusses of the carpentry. A simple building is composed of two eave and two gable walls. According as the building is turned, it presents as its facade either a gable or eave wall. The facade of a Greek temple is an actual gable wall. The north and south portals of the transepts of the cathedral of Paris are terminated by two gables. Houses erected during the Romanesque epoch in France usually present an eave wall on the street, their gable walls then being party walls, but later and about the middle of the 13 th century, the habitations sometimes show one of the gable walls on the street. This method became customary during the 14 th and 15 th centuries, and then the gable walls were frequently built of half timber work. (Arts. Maison, Pan de bois).

The form of construction suited for masonry gables greatly occupied the architects of the middle ages. Indeed, a gable

exceeding the ordinary dimensions only acquires and retains i its stability only in certain conditions, that it is well not to neglect. If a gable wall be a party wall between two buildings; if properly speaking it is only a division wall maintained at both sides by the carpentry of two equal roofs, it is clear that to render it stable, it is only necessary to e erect it in a vertical plane and give it a thickness in proportion to its height; but if this gable wall is detached at one side and loaded at the other by chimneys, pushed or pulled by carpentry not absolutely fixed, if one claims to maintain it in a vertical plane, it is necessary to take certain suitable precautions to ensure its stability. If the isolated gable walls are very high, they present a great area to the wind, their tops not being loaded may be inclined under weak pressure, either inward or outward, and those great triangles rocking on their bases very easily leave the vertical plane, however small the force that affects them.

When during the Romanesque period, the roofs had an inclination barely attaining 45°, the construction of gables did not demand special precautions; the gable was scarcely more than a wall terminated by two slopes. But when one came to give to the carpentry of roofs an inclination exceeding 45°, and this carpentry had a span of 39.4 to 49.2 ft., it was indeed essential to adopt extraordenary means to maintain in a vertical plane that enermous triangular masonry at the tops of edifices, left to the gusts of wind and to the inevitable movement of the timbers.

Yet already about the last time of the Romanesque period was felt the necessity, for making gables something else than a simple wall terminated at top by an obtuse angle. men believed tha they must ensure its stability by means of arches, t that transferred the loads to certain points. We find an example of one of those attempts on the front wall of the church of S. Honorat in the island of Lerins.[1] The gable of this facade is presented in Fig. 1, and its construction dates back to the beginning of the 12 th century, but it is really composed of four wide piers A with a central opening and flying buttresses; thus the load of the masonry was concentrated at four points from B to C. This construction was the result of judicious observation. Indeed, masonry acquires a great part

of its stability by its weight rather than by the area occupied. If (Fig. 2) we erect a solid gable A 13.1 ft. high by 26.3 ft. wide and 1.64 ft. thick, we shall have in elevation a built surface of 172 square ft. and a volume of 285 cu. ft. Taking the weight of a cu. ft. of cut stone at 125 lbs., the load will be 35,270 lbs, and the loaded area will be 45.06 sq. ft. The load being distributed over that area, one square ft. of horizontal area a b will receive 819 lbs.; one sq. ft. of a c or b d will receive 584 lbs.; one sq. ft of c e or d f w will have 351 lbs.; one sq. ft of e g or f h, 117 lbs.; total 35,270 lbs. But if without changing the dimensions or thickness, and consequently the weight of the gable, we build discharging arches buried in the masonry as indicated at B, we shall have one sq. ft. of horizontal area a b loaded by 445 lbs.; one sq. ft. of a c or b c with 960 lbs; one sq. ft. of c e or d f with 222 lbs. In the first case A, the part most loaded is the part a b, that receives 819 lbs per sq. ft., while in the second part B, the part a c or b d receives 960 lbs. per sq. ft. In example A, the areas e f or g h receive only 15,432 lbs., while in the second the same surfaces receive 18,078 lbs. In example A the areas e f, g h, each receive 2,205 lbs., in example B the same surfaces have 4,630 lbs. Thus in the second example the loads tend to equilibrate or to distribute themselves more uniformly over the entire base; the greatest load is not at the middle of the base, but is transferred to two points. A force like the wind or a thrust then finds a resistance more solidly resting on its base, and opposed to its action. The entire system of construction of the great gables of the wise epoch of the middle ages is established on that very simple observation of the distribution of the loads, not according to the slope given by the form of the gable, but contrary to that inclination as much as possible. The decoration of these gables is derived from the system of construction adopted. When the building contains only one nave, the points op support are transferred to the two ends; the triangle of the gable is terminated by two abutments; but when the building is divided lengthwise by a wall or a row of piers, the gable indicates the internal construction, and its middle is maintained by a buttress that rises to the apex of the triangle. If there be a fireplace against the interior on the axis of the hall, its

flue appears on th exterior and rises to the apex of the triangle in the best conditions of draft, and serves to abut the construction.

Note 1.p.131. The island of Lerins, that possessed a beautiful old abbey, is situated before the island of S. Marguerite, opposite the roadstead of Cannes.

However these principles of construction of gables were adopted rather late, about the middle of the 12 th century, we see gables built, that are only solid triangular walls, decorated by slightly projecting members, arcades, laps and panels, that add nothing to the stability.

The Latin church of S. Front preceding the existing church, which dates from the end of the 10 th century, possessed at the west a gable of which some traces are seen, and which was built according to these elementary principles, already appearing on the exterior of the monument of Poitou known under the name of the temple of S. Jean.[1]

Note 1.p.132. In Architecture Byzantine en France, by M. F. de Verneilh, see the description of the gable of the old basilica of S. Front, and the engraving added, p.93.

The churches of the Basse-Oeuvre at Beauvais and of Montmille present their western gables simply ornamented by a cross and some imbrications.[2] But one of the richest amon these gables of Beauvoisois is that which closes the north transept of the church S. Etienne of Beauvais. This gable that some authors date back in construction to the beginning of the 11 th century, cannot be earlier than the beginning of the 12 th. It crowns a rose window surrounded by a series of figures representing a wheel of fortune.[3] The structure of the external surface of the gable wall is entirely composed of very small cut stones, forming a lattice of beams by the manner in which they are set, between the intervals of which are inserted rosettes carved on the surface of a stone.(Fig. 3). This lattice is intersected horizontally by a line of billets and by a very small rectangular opening covered by a round arch cut in a s single stone. The angles at the sides and apex of this triangle were restored in the 14 th century, and their original t terminations were replaced by three pinnacles. We have tried to supplement this lack by depending on vignettes of manuscripts of the time. The imbrication of the little rubble stones

forming the external decoration are cut as indicated by detail A, and have but small thickness; this is only a facing placed before a wall of ordinary masonry. The rake copings cover the whole and form a fillet over the tiles.

Note 2.p.133. See Monuments de l'ancien Beauvoisois, by M. Woillez. 1849.

Note 3.p.133. Art. Rose. Also see Album of Villard of Honnecourt, Pl. 41.

A little before the construction of this gable was erected the church of Notre Dame du Port at Clermont in Auvergne, whose gables were richly decorated by billets and incrustations of stones of two colors (white and black). We give (Fig. 4) an elevation of the southern gable of this church. Here the construction is most rational. The cornice of the eave walls passes across the base of the gable and is skilfully stopped by the two buttresses A and B. This cornice accents the crowning of the edifice, and the triangle of the gable is only the mask or the covering, that it covers by means of the projecting o coping forming the upper rake. These two examples and those of S. Front and of Montmille show that the Romanesque architects sought to give a certain relative richness to the gables of e edifices. These triangular tympanums crowning the walls are seen afar because of their height, and appear to allow an entirely special decoration recalling the wood construction of roofs, that they were designed to conceal. At Notre Dame du P Port, the lines of billets inserted in the masonry and serving to enclose the mosaicr assumed the arrangement of carpentry. At S. Etienne of Beauvais, a lattice of rounds seems to be placed before the roof. But the lateral terminations are two angles more or less acute without abutments, returns and often without acroterias, were lean and caused a fear of the slipping of the copings. There was necessary at those two angles a stop or a weight, or at least a returned moulding. The form of the carpentry of the roof masked by the gable further required a particular arrangement. Indeed the eave walls of an edifice (Fig. 5) being given, those eave walls were crowned by a cornice slab A receiving the furrings and drain of the r roof B (gutters were not in use in the 12 th century); erecting a gable before this projection, it was either necessary that the cornice A should return at the base of the gable,

that it should stop abruptly at the face of the wall, or that it should be masked by a projection a b; it was further necessary for the coping crowning the gable to serve as a fillet covering the roofing, to prevent rainwater from passing between the rear face of the gable and the tiles or slates. Then (about the middle of the 12 th century) the architects sought different combinations more or less ingenious to satisfy these conditions. The simplest of these combinations, adopted in a many edifices of Burgundy and upper Champagne about the middle of the 12 th century, is that which we present (Fig. 6). The cornice of the eave wall being extended to the face of the gable wall, its projection receives the lower ends of the triangle elevated in such a manner as to free the covering and cover it by means of the projection a of the coping. But for this coping to not slip on the slope od the triangular wall, it m must necessarily form a part of the course d as indicated in detail A. Then the block d was sufficiently heavy to arrest the slipping of the inclined slabs e. In cutting this stone from the block the masters were naturally compelled to remove the triangle g. Soon instead of that, they left the stone entire and profited by this triangle g remaining to make it a little gable, as we have sketched in detail B. That reserve had the advantage of leaving more weight to the stone, avoiding a hollow, and affording to the eye more stability to that stop course.

Even in conditions built with economy, we see that the architects devote very particular attention to crowning the gables, so as to prevent the passage of rainwater between the roofing and the masonry, without ever having recourse to those flashings of mortar or of plaster, that are easily detached, require continual repairs and have a miserable appearance. Sometimes the tiles cover the rakes of the gables, but at the apex is set a crowning stone covering both slopes of tiles and the ridge tiles of terra cotta, as shown by Fig. 7.[1] At A the terminal of the upper apex of the gable is presented in profile, and at B in perspective. Thus the wall is perfectly preserved by the covering tiles, and the junction of these at the ridge is secured by the terminal stone forming fillets at the sides, in front and behind.

Note 1.p.137. From a chapel of the little church of Flavig-

Flavigny, 15 th century. We have found terminals of this kind on Burgundian gables of houses of the 13 th century.

The system of carpentry and of roofing adopted at the beginning of the 13 th century usually producing an equilateral t triangle and sometimes one even more acute, gables assume importance, the edifices being erected on a greater scale than in the preceding centuries, it became necessary to give a bearing suitable for this work in masonry, to combine it with more art. Presenting a very large surface, it was necessary both to decorate and to lighten them, the more because they rose above great openings, rose windows, wide windows, lighting the interiors of the naves. Then the constructors sought to stiffen these great walls left to themselves by combinations of piers and voids skilfully arranged. They erected gables in Burgundy (a province of gold constructors) during the first half of the 13 th century, singularly bold in construction and with a very remarkable decorative effect. We have seen two, built at the same time before the porch of the abbey church of Vezelay and before the nave of the little church of S. Pere-sous-Vezelay,[1] which present both bold construction and a decoration of extreme richness. The gable of the western front of the church of S. Pere had been built with a foresight of the raising of the nave, that never occurred, so that today this gable rises much above the roof. It was to be flanked by two high towers: that on the north alone was built (Art. Clocher, Fig. 70). A great arch (Fig. 8) was designed to trace the penetration of the vault on the front. Beneath this arch opens a rose window that surmounts an opening with tracery.[1] The e entire decoration above the archivolt must mask the carpentry, and it presents in an arcade a series of statues of large size. At the top is seated Christ blessing, crowned by two kneeling angels. Beneath Christ stands on a pedestal S. Etienne, then at the right of Christ is the Virgin and on the left is S. Anne. On the right of the Virgin gradually descend the statues of S. Pierre, S. Andrew and a third apostle. On the left of S. Anne are S. Paul, S. John the apostle. Beneath the statues of S. Anne and of the Virgin are seen two heads of demons; the o other statues are supported by piers or corbels. Beside the rose window are sculptured the lion and the dragon. The iconography of this gable is then complete and has suffered no

serious mutilations. As for the construction of this important piece of architecture, it consists of a wall built in low courses, stiffened on the exterior by the arcade composed of high courses. The two towers were to abut its two ends; that of the north alone having been built, the gable has bent at the south end; but it was easy to stop that movement by means of a buttress built inside on the wall of the nave, whose existing vault does not exceed the level A. It is not necessary to emphasize the value of this truly masterly composition, and it must be stated that the statuary as well as the ornamental sculpture is treated by a master's hand. The figures are a little t tall in elevation, but assume their true proportion in perspective, and form an entirety, surprising by its rechness and the beautiful harmony of the lines.

Note 1.p.138. S. Pere for S. Pierre.

Note 1.p.139. This rose window now opens under the roof of the nave.

The gable of the western front of the abbey church of Vezelay was very probably by the same artist, aud presents a different arrangement, still more original. It serves as a tympanum for the vaults of the porch that date from the 12 th century; the arcade is open, and lights the porch, and the figures are pa placed on piers. But perhaps a unique fact, the rakes of this gable, instead of being straight, are formed by two curves p producing a pointed arch (Fig. 9).[2] The statues decorating th this gable, as at the church of S. Pere, present at the top the seated Christ holding the book of the gospels and blessing; two angels bear a large crown above his head. On the right of Christ is the Virgin and on here left is S. Anne. Two angels holding censers complete the series. Below are seen on the c-columns S. John Baptist, S. Pierre, S. Paul and S. John, a b bishop and a saint, that we ar unable to designate. The section of the pier forming the mullion is given by the detail A. The glass being placed at B, there exists a passage between t the glazed arcade and the internal somewha lower arcade (Fig. 1). The construction of this gable is to be studied and explained by the internal elevation. The curve A is that given by the side arch built in the 13 th century under the vault B of the 12 th. A discharging arch C strengthens the side arch and passes under the gallery.(See section D at C'). A second disch-

discharging arch E E′ supports the weight of the upper extremity of the gable, the trace of the roof being at a b. Piers F, F′ maintain the facing G G″ forming the back of the external decoration. The little columns H are isolated and are indicated in the horizontal section of one of the piers of Fig. 9, are then relieved by the side arch, by the arch C′ and by that at E′. Further, from the level I they are connected to the p portion of the pier on the exterior by projections K rising to beneath the discharging arch C′. The passage L communicates by some steps with the halls of the second stories of the two towers flanking the facade. On the interior as on the exterior this great window produces much effect, and its double arcade is arranged according to a very extended perspective purpose; the balustrade M being only high enough to mask the sill N of the glazed openings; the arches O permitting to be seen in their entire development the openings of those at P, and the s small diameter of the little internal columns H in masking the glass. All that is built in beautiful materials, and the sculpture is treated by a master's hand and dates from the middle of the 13 th century. The statuary i impressed by a grand character, and frankly appears of the beautiful Burgundian school. (Art. Statuaire).

Note 1.p.139. At the scale of 1 : 100.

At the same epoch in Ile-de-France were erected gables perhaps conceived with less boldness, with an arrangement less original, but in the composition of which is observed a more correct taste, more delicacy and better harmony with the purpose. One notes that the gable of Vezelay is a mask of the r roof, but hardly combines with its form. In our good Gothic edificesof the 13 th century, those of Ile-de-France, those to which it is always necessary to resort as being the truly classical expression of this art, the gables are indeed made to close the roof, they frankly light and cover it. We cannot find a better example than that furnished by one of the gables of the transepts of Notre Dame of Paris (1257). This gable ri rises above a rose window 42.7 ft. diameter, and it is itself pierced by a rose window partly blind, that lights the roof. This beautiful composition (Fig. 11) is equally decorative a and wisely reasoned. On the great arch that is the side arch of the vault and the archivolt of the rose window is placed

an entablature supporting a balustrade, and that permits communication from the upper galleries at the east with those at the west. The gable proper rises as a recess from the arch of the rose window and rests principally on the side arch; it is more supported by a relieving arch embedded in the construction. This gable is 2.- ft. thick, is lightened by the rose window that lights the roof, and whose blind portions are only slabs bearing sculptures, by rosettes and reveals. Two great pyramids flank it and form the heads of the buttresses abutting the rose window, and permit a rear stairs to extend a and pass above the roof that it covers, at the junction to which it forms a wide fillet, as shown by section A of the portion of the rear gable at B, the section A being made on a b. Three statues decorate the summit of the two lower angles of the gables. That of the apex represents Christ appearing in a dream to S. Martin, clad in the half cloak given to the poor;[1] the two others represent the same S. Martin and S. Etienne.[2] Lighted by the sun, this gable produces a marvellous effect. Further it perfectly emphasizes the roof that it is intended to close; its sculpture is broad, sober, at the proper scale and admirably treated. The rose window of the attic is in perfect proportion to the great rose window that opens in the transept. This composition was never surpassed. The south gable of the cathedral of Amiens was erected about the middle of the 14 th century, and still presents an original arrangement, that approaches the composition of the gable of Vezelay. The great triangle is divided vertically by piers forming a series of buttresses decorated by statues and pinnacles, between which open voids that light the attic. But there the details are too small in scale, are confused and no longer offer that simplicity of lines, that we admire at Paris and even at Vezelay. To not leave these great triangles isolated, men sometimes had the idea in the 14 th and 15 th centuries to abut them by open or blind galleries, that connect their rakes to the abutting pyramids or turrets. One of the best composed of this kind is that of the principal facade of the Church S. Martin of Laon, which dates at the end of the 13 th or beginning of the 14 th centuries. We give (Fig. 12) a perspective view of it. Desiring to give great importance to the two flanking turrets, the architect felt that the gable

between these two turrets would appear meagre; so he has accompanied it by a blind gallery, which terminates the portal rectangularly as a mass, and yet he did not desire to falsify the principle, and he has caused the outline of the roof to reappear through the gallery.

Note 1.p.144. Below the portal is represented at right and left the legend of S. Martin.

Note 2.p.144. The legend of S. Etienne is represented in t the tympanum of the portal.

A little before the construction of S. Martin of Laon, the celebrated architect Libergier during the second half of the 13 th century erected over the portal of the church of S. Nicaise at Rheims a gable joined to the two towers of the facade by an open gallery, which was much more truthful than the mode adopted at S. Martin of Laon. This gallery also places in communication the upper stories of the towers.[1] The gable of S. Nicaise of Rheims was pierced by three round windows 1 lighting the attic, and its front was decorated by imbrications, the last vestige of that Romanesque tradition tha we saw frankly accepted in the gable of the church S. Etienne of Beauvais, given above, and in the gables of the provinces of t the Centre and West. As at the cathedral of Rheims, the western gable of S. Nicaise was double, repeated in the plane of the rear sides of the towers, and like the front one, this second gable was joined to the towers by an open gallery like that in front. One understands what effect in perspective could be produced by this doubled gallery. We give (Fig. 13) an elevation of the gable of S. Nicaise.[2] It must be stated that the little columns supporting the gallery were doubled to give the depth necessary for a passage on the arcade. (See detail in section A).

Note 1.p.145. Art. Clocher, Fig. 75.

Note 2.p.145. See the precious engraving of De Son of Rheims. (1625). That beautiful church, unique in its kind, was destroyed without reason or necessity at the beginning of the (19 th) century.

It is unnecessary to believe that religious architecture a alone erected works of great importance and richness. The gable of the hall of the palace at Poitiers is one of the richest

that one can imagine and one of the most singular in composition. At its base inside is established a fireplace occupying its entire width, the flues of that fireplace boldly pass across the windows that open in the gable. One can obtain an i idea of that composition by examining Fig. 10 of Art. Cheminee (15 th century). The gable of the great hall of the castle of Coucy was also very richly decorated on the exterior (Art. Salle), and was surmounted by a colossal statue. An immense opening was made under its triangle and largely lighted the hall lengthwise. That gable belonged to the structures erected by louis of Orleans during he first years of the 15 th century. Among gables in civil architecture the more simply treated, must be cited those of the keep of the castle of Pierrefonds. We present two specimens of them (Fig. 14). They o combine with the buttresses of the castle as one may see at A. Behind the projecting crenelations and following the slope of the roof is placed a service stairs for the roofers, that at need could be occupied by defenders. At B is given the section of this gable, the step being profiled at a and the ridge of the roof at b.

The gable C that belongs to the same castle is furnished w with triple chimney flues d, that interrupt th stairs, which then continue by means of lead steps on the roof. At D we give one of those gables of barns of the 13 th century, with i its axial buttress designed to abut the thrust of the arches resting on a row of columns and reducing the spans of the carpentry. The architects of the middle ages did not commit the fault of equipping gables with buttresses according to the i internal arrangement, either to mark the division walls or to abut the arches. They made proof in that important part of t their edifices of the freedom that we love to find in their most modest works, as well as the richest. The gable emphasizes the cross section of an edifice, and it is then the part that indicates most clearly its construction and purpose, the architects have thus understood its function, and have been very careful not to conceal it. To see a gable from the exterior, one easily seizes the different divisions of the building and its construction, whether it is vaulted or ceiled, if it only has a ground story, or is composed of several stories. The chimneys are habitually placed in the axes of the gables,

so as readily to bring their flues to the ridge of the roof and avoid their isolation. Thus these flues form actual buttresses, which stiffen the great triangles of masonry and give them more bearing. The establishment of gables on civil edifices also had the advantage of avoiding hips in carpentry, costly in construction and maintenance, and of furnishing fine attics well enclosed, ventilated and healthy.

PILASTRE. Pilaster.

During Grecian antiquity the pilaster or rather the ante, as this word sufficiently indicates, is the head of a wall, or a projecting angle built at the square return of a wall. On the wall of a cell, the ante is the reinforcement erected at A or B (Fig. 1), which reinforcement bears a capital and sometimes rests on a base. In Roman architecture, what is called a pilaster is the projection of a column from the face of a wall marked by a small projection (of the wall) (Fig. 2), A being a column and B its pilaster; sometimes the isolated or engaged column disappears, for example as around the upper s story of the Coliseum at Rome and the pilaster alone remains. During the best period, the Greeks never gave to the ante the same capital as the column; but under the empire the capital of the pilaster is only the projection of the capital of the column, as the pilaster itself is merely the projection of t the shaft. If the pilaster be alone, if it is not the projection of the column, it has the capital of an order, Doric, I Ionic, Corinthian or Composite, but does not take a special capital.

In the first times of the middle ages the architects did not take the trouble to project the engaged column on the wall, but they sometimes placed pilasters as a decoration or reinforcement of a wall. Small pilasters are seen on the exterior of the monument of S. Jean at Poitiers; they are again found on the western gable of the Latin basilica of S. Front of Perigueux, accompanying two stories of arcades,[1] and later about the end of the 10 th century, in the interior even of that e edifice. These pilasters are crowned by false Corinthian capitals, and bear an upper arcade (in the tympanums closing the great bays of the domes), that form a continuous passage around the edifice. Windows are opened in the arcade beside the

choir and the transept. But this example that is found repeated in the old part of the church of the city (cathedral) at Pereguеux, is not generally followed in the edifices of the West. The engaged column replaces the pilaster, while in upper Burgundy, Morvan and upper Ghampagne, the Roman pilaster persists very late, until the beginning of the 13 th century. There still exist at Autun two city gates of the Gallo-Roman epoch, the gates of Arroux and of S. Andre, that are crowned by a defensive gallery consisting of a series of arches between which are arranged pilasters, fluted at the gate of Arroux and plain at gate S. Andre. This arcade with pilasters evidently served as a type for the architects, who in the 12 th century erected the cathedrals of Autun and of Langres, of t the churches of Saulieu and of Beaune. But whether there still existed at that epoch great Roman monuments with pilasters, o or that the galleries of the Roman gates of Autun may have i inspired the architects with the idea of using the pilaster, and the fluted pilaster, in the composition of the piers themselves of the edifices cited, we see the pilaster applied on a great scale at Langres, Autun, and in some other monuments of those provinces. At Langres great false Corinthian pilasters form the heads of the buttresses of the apse on the exterior. At the cathedral of Autun, the internal piers have engaged f fluted pilasters (Art. Pilier). Even at Vezelay in the nave above the archivolts of the side aisles, pilasters bear the side arches of the great vault, while one never sees pilasters employed in the Romanesque edifices of Ile-de-France.The pilaster is also sometimes employed in certain Romanesque monuments of Provence, and it is habitually fluted. In fact in French architecture of the middle ages, the pilaster is an exception, and its use is due to the near presence of Roman monuments.

Note 1.p.150. In Architecture Byzantine en France, by M. F Felix de Verneilh, 1851, see the description of the Latin church of S. Front, p. 98

PILE. Pier. (Art. Pilier).

PILIER. Pier.

An isolated vertical stone support intended to bear the car-

carpentry or vaults of edifices. The pier belongs to the architecture of the middle ages. The Greeks and Romans built no piers, properly speaking, for this name cannot be given to t the column nor to those thick and compact masses of concrete, that in the great Roman edifices, for example, like the halls of the baths, supported and abutted the vaults. The pier is t too slender by itself to resist oblique thrusts; for it to r retain the vertical line, it must be loaded vertically, or t the resultants of the thrusts of vaults acting on it must neutralize each other so as to combine themselves in a vertical pressure. When the naves of churches or halls were covered by carpentry, there was no need for giving the pier extraordinary strength, and for seeking by the combination of their horizontal section to resist the oblique pressures of vaults; but when men claimed to substitute the vault for carpentry for c covering interiors, the constructors endeavored to give to t the piers forms suited to fulfil that new purpose. They first increased out of measure the diameter of the cylindrical column, and then grouped several columns; then they added to piers of square section engaged half columns; they sought thus resistant combinations up to the moment when about the middle of the 12 th century that architecture adopted an entirely n novel system of construction. Then the pier was further only the derivative of the vault or of the pressure acting on it.

Better than any other architectural member during the middle ages, the pier expresses the attempts and efforts of the architects and the logical results of the principles, that they adopted at the moment when the art came into the hands of the lay schools; thus we must enter into explanations sufficiently extended concerning the curious transformations, that the pier suffered from the 10 th to the 15 th centuries.

In the Roman basilica the pier is nothing but the column supporting a vertical wall, either by lintels or by arches. On two rows of columns rise two walls; on these two walls from one to the other extends carpentry. A vertical pressure, indeed quite weak, consequently a sufficient resistance if the columns were of hard stone, of granite or marble. Well built walls of brick are not heavy; carpentry, however wide, exerts only a very weak pressure. But when from the art of construction practised by the Romans, one falls into a coarse imitation

of that art, and when for thin and well bonded walls with excellent mortar and covered by indestrictible plastering, or built of cut stones set with dry joints, one must substitute walls of roughed rubble badly bonded and filled with bad mortar; then it was necessary to give these walls a greater thickness and consequently a greater weight, and to the columns or piers a greater section. Besides, the Romanesque constructors during the Carlovingian period could neither quarry nor cut monolithic columns of marble, granite or hard stone, they composed them of low courses of stone, and even sometimes of rubble. The reinforced piers did not always resist the loads imposed on them, they flushed and cracked; men increased their strength beyond measure to avoid accidents, and adopted rectangular sections; their courses were thus more easily set and were more resistant; frequently they were given a thickness much greater than that of the walls, whose weight they had to support.

Many monuments of the 10 th and 11 th centuries have retained piers in the construction of which are observed experiments, the attempts of constructors, rarely satisfied with the result obtained; for these piers were not only ungraceful and badly connected with the upper parts, but again they occupied a considerable area, encumbered interiors and obstructed circulation. Thus it is not rare to see in the same edifice piers built at the same time and taking different forms, as if the s architects must try all, while in the impossibility of finding one that could satisfy them. During the 11 th century we see simultaneously employed piers of square section, square with angles chamfered, round, lobed, square with attached semicircles, rectangular, circular surrounded by a series of sections of circles, etc.; but nothing is decided, nothing is d definite, no system prevails.

In the little church of Vignory,[1] the walls of the nave are separated by a series of piers of rectangular section; then the last bay next the choir presents piers of round section. (Fig. 1). Above the pier of round section A is placed the form of false triforium B, a pier of square section with rounded a angles.[2] The architect, mistrusting the smallness of his materials, did not dare to erect the piers of the nave to the me height of the ceilings of the side aisles, but he stayed them

lengthwise by arches C (see section), that support the opening with no other purpose than to make the nave wall lighter and to decorate the interior. In the church of Bonnell-en-France, we see piers of the 11 th century, whose section is given at A (Fig. 2) supporting archivolts with double voussoirs; but here appears the methodical spirit of the artests of Ile-de-France; the section of these piers is caused by the upper construction, and one feels the influence of a school whose principles are already reasoned. These piers are well built in regular courses. The mouldings are not returned on the faces, which is p perfectly justified by the construction.

Note 1.p.152. From the 10 th to the 11 th centuries.

Note 2.p.152. See monograph of the church of Vignory made according to the drawings of M. Boeswilwald. (Archiv. des mon-hist. pub. sous les ausp. du ministre d'Etat.

In the nave of the church of S.Remi of Rheims, erected about the end of the 10 th century (we are speaking of the primitive constructions), are seen piers whose singular form appears to be without any motive. These piers (Fig. 3, 3 bis) consist of a cluster of segments of little columns, whose horizontal section gives the outline reproduced in Fig. 3. A circle having been drawn with radius A B, this circle is the plinth of the pier; having been divided into seven equal parts, there is obtained a polygon that gives the plinth of the bases of the little columns. The radius A B having been divided in two equal parts A C, B C, the points C then give the centres of the seven large columns. The intersections of the segments of these larger columns then give the centres of the seven other columns, the toruses of whose bases are tangent to the sides of the polygon. The archivolts H H, I I, of the face F G of the wall rest awkwardly on this pier, as easily seen by the drawing. The transverse arch K L of the side arch springs below that of the archivolts, which causes the abacuses of the capitals under that transverse arch to abut against the shaft of the pier, and the abacuses of the capitals bearing the archivolts penetrate the transverse arch. The perspective of th this pier (Fig. 3 bis) further explains these eccentricities, and how all the capitals, except those bearing the transverse arches, are inscribed in a circle of the same diameter as that giving the horizontal projection of the plinth. It would seem

that the architect desired here to obtain a powerful resistance and a light appearance by these divisions of the great s shaft in o portions of intersecting cylinders.

In the church of S. Aubin of Guerande, the construction of the nave dates from about 1130, and rests on piers alternately cylindrical and compound. Here (Fig. 4) is one of the latter. The horizontal section traced at A gives four great half columns 2.0 ft. diameter and four thinner ones 1.3 ft. diameeter. The bases of the columns are round and rest on a plinth also circular, enclosing the eight partial bases and forming a plinth. The horizontal projection of this plinth gives that of the abacus common to the eight capitals, bearing in front a pier of trapezoidal section, archivolts in two rows E, D, and a transverse arch on the side aisle. The pier C (see elevation F) only supports the tiebeams of the carpentry, this nave not having been vaulted originally. The construction of these piers is much better understood than that of the piers of the church of S. Remi of Rheims, for here each engaged column already has its distinct and well motived foundation. The perspective sketch B explains the arrangement of the eight capitals grouped beneath the circular abacus.[1]

Note 1.p.158. These drawings were furnished to us by M. Gan-chenal).

The church of Lons-le-Saulnier shows us a nave of the 12 th century resting on piers alternately cylindrical and with a polygonal section, terminated by square endings forming capitals and receiving directly the imposts of the archivolts. (Fig. 5).

The 12 th century presents a great variety of piers. The c constructors sought means to erect vaults over Romanesque naves, which until then had been habitually without them (at l least in the provinces of the North), and passed from the cylindrical column to the square section, to a group of cylinders, to a square pier with engaged half columns, without finding a form definitely suited for these supports; for each day brought a new mode of construction of the vaults, and very often while the piers were built, there occurred an improvement in the manner of arranging the imposts, that could only be employed with difficulty on the piers prepared before the knowledge of the advance. That explains how many edifices of the l

last Romanesque period, one sees arches resting awkwardly on piers, that evidently were not designed with foresight of the form of those vaults.

There is a school that experiments little, the Burgundian, or rather the school of Cluny. Thus in those edifices due to that order one already sees from the beginning of the 12 th century,appear piers very frankly arranged to receive vaults such as were conceived at that epoch. The piers of the abbey church of Vezelay, erected at the end of the 11 th century and during the first years of the 12 th, are already traced on a plan coinciding perfectly with the construction of the vaults. They are formed by the intersection of two rectangles with f four engaged half columns.

Fig. 6 gives at A the horizontal section of these piers at the level a b, and B is their section at the level c d. C is the elevation of the pier next the nave, and D is the section of the bay through the middle of the archivolt. It is seen th that above the band G, the wall of the nave recedes to leave the pilasters H already intended to support the side arches I, on which rest the groin vaults without diagonal arches. Buttresses K alone were originally intended to abut the great vaults, and rest on the imposts L of the transverse arches of t the side aisles. Here the capitals are placed at the springings of the archivoltr and the transverse arches, so that having the same diameters, the front engaged columns V are much longer than the columns M and N. Thus from that epoch the principle of subjecting the heights of the columns to the springings of the arches is adopted. It is the vaults that determine the arrangement. The columns are engaged for only one third, so as to leave to their diameters entire purity, which is an important point, for every column engaged for half its diameter, py the effect of perspective, never appears to have its actual thickness. It is evident that in the nave of Vezelay, the architect knew from the bottom of the edifice how he could vault it; the transverse arches rest fully on the projections of the capitals and on the square pier to which the columns a are attached; the side arches of the great vaults find their points of support, and the groins of the vaults have their p places in the reentrant angles, as in Roman construction.

The piers of the cathedral of Autun of a more recent epoch

(about 1140), but belonging to that beautiful school of upper Burgundy, likewise merit our attention. In horizontal section then consist of two intersecting rectangles with engaged fluted pilasters and not columns. It is necessary to note that the principal nave of this church has a true vault and not o cross vaults, as at Vezelay. Its piers are further arranged f for this sort of construction. Section A is made on a b (Fig. 7), section B on c d and section G on e f. The transverse arches D rest on the top of the pilaster rising from the ground, and the rib that encloses it at the extrados rests on the little columns E. The lateral pilasters i stop at the springings of the archivolts of the side aisles, and that behind receives at the same level the transverse arch of the side aisles. Then as at Vezelay the springings of the arches of the vaults determine the heights of the engaged columns or pilasters; b but to not give the front pilaster a length out of proportion, the architect has taken care to cut it by the bands n and m. It is unnecessary to emphasize the study of proportions and of details that appears in this example of architecture. One would think that he saw there a fragment of those very delicate Greco-Roman monuments, that count M. de Vogue discovered in the vicinity of Antioch and Aleppo. It is not the sculpture that recalls that oriental school, so brilliant in the 5 th century; and although the Gallo-Roman gates of Autun could inspire the architects of the cathedral of the 12 th century w with the motive of the arcade of the triforium, they certainly took elsewhere their mouldings and ornamentation, these m mouldings and ornaments being of a style entirely different f from that of the Gallo-Roman edifices, and of much superior execution.

This motive for piers has been followed in the construction of Notre Dame of Beaune, S. Andoche of Saulieu, and the cathedral of Langres, for the cathedral of Autun formed a school.

The school of Ile-de-France at the moment when architecture passed into the hands of lay architects, must break with those traditions, that seemed so well established in the provinces of Burgundy and of upper Champagne. About 1160 these architects of Ile-de-France attempted to combine the old Romanesque ideas with the new system that they introduced; they still r retained the cylindrical column, and only commenced above those

columns the arrangement imposed by the cross vaults.

This principle is frankly emphasized in the interior of the cathedral of Paris. The piers of the choir of that church were erected about 1162, and those of the nave about 1200, and they present nearly the same arrangement. The piers of the choir, whose horizontal section we give (Fig. 8), consist of a great cylinder 4.3 ft. diameter supporting a wide capital with square abacus, on which rest the archivolts bearing the walls a b, c d, the transverse arches of the side aisle and the diagonal arches f. The three little columns g, h, h, extend to the springings of the great vaults to carry the transverse and diagonal or side arches. At the height of the triforium, the cylindrical section of the pier divides as indicated in the Fig. into as many members as there are vault ribs to to be borne. In the nave (Fig. 9) the section of the pier of the triforium is simplified; the pier is built in courses and presents only square returns or pilasters, and the little columns ar detached as monoliths. Later in the piers near the towers and about 1210, the constructors hav even attached afterwards to the ground story an engaged column A to support the appearance of the overhang of the little front columns resting on the abacus, or rather to abut the great cylinder and prevent it from overturning. This was a transition.

See (Fig. 10) what is the construction of the piers of the nave of Notre Dame of Paris in elevation.[1] It is clear that the arrangement suited to the new system of construction then adopted only commences at the level A, i.e., above the abacus of the capitals of the columns of the ground story. Those form a separate arrangement, the lower pillars. This system persits longer in Ile-de-France than elsewhere, and the architects only abandoned it with difficulty. Yet already at Paris in the construction of the cathedral itself, they had erected in the side aisles of the nave cylindrical columns with attached attached round columns. (Art. Construction, Figs. 92, 93); but t this system had been imposed on them by the necessity for giving at those points of support an exceptional resistance. We see that at the cathedral of Laon without any apparent reason, about the same epoch or about 1200, the architects added to t the great cylinders of the ground story detached cylindrical columns, as an attempt or expedient, and start toward a new s

system of construction of the piers. On 20 piers that bear t the triforium of the vaults of the nave of Notre Dame of Laon, only four present that peculiarity of little columns placed at the angles of the front of the base, as indicated by the h horizontal section (Fig. 11). The three little columns a, b, b, relieve the abacus of the great capital and receive the 5 little columns that support the transverse, diagonal and side arches of the great vaults. As for the li tle columns c, they receive the imposts of the diagonal arches of the vaults of t the side aisles. In perspective, these piers present the appearance reproduced in Fig. 12. It is true that these 4 piers are placed beneath the springings of vaults, which at Laon as at Notre Dame of Paris comprise two bays, but it is not explained why this very good system was not preserved along the entire length of the nave. The bands A form a course connecting the upper shafts B with the lower shafts C. The constructors of the cathedral of Laon did not have the fine lias of Paris, and they could not cut conolithic shafts of great length. So they joined the shafts by these courses of bands repeated several times in the height of the piece, as seen at D. One will note that the capital of the great column comprises two courses, while capitals of the little columns standing on end are made in a single course in a single block with the second course of the grea capital. This principle is followed quite r rigorously during the first years of the 13 th century.(Art. Chapiteau).

Note 1.p.162. Art. Cathedrale, Figs. 2, 4).

Some years before the construction of the cathedral of Laon, i.e., about 1170, there was erected in the same city the nave and choir of the church S. Martin, and the architect retained the body of the Romanesque pier, in horizontal section formed of intersecting rectangles with an engaged column next the gr great nave to receive the transverse arch; but in the 4 reentrant angles left by these rectangles the architect already set little columns on end to receive the diagonal arches of the upper and lower vaults. (Fig. 13). These little columns were c composed of several pieces retained by bands as shown by the perspective view. But these piers had the inconvenience of g giving a considerable section occupying much space, obstructing circulation, and restricting the view of the sanctuary;

yet those 4 little columns being arranged to receive the diagonal arches probably gave to the architects of the cathedral of Laon the idea of attaching to their cylindrical pier 5 little columns, one intended to bear the transverse arch of the great nave, and the four others to support the diagonal arches. Soon was adopted a more radical system, to the great cylindrical column were attached 4 engaged columns receiving the two transverse and the two archivolts, the diagonal arches and the side arch then rested on the great capital of the principal cylinder, and those of the vaults of the great nave on the little columns set on end and resting on the projection of the abacus. According to this system were erected the piers od the cathedral of Rheims (Fig. 14). At A we give the section of th these piers at the level of the ground story, the great nave being on the side N. The great cylinders have a diameter of 5.25 ft.; in the direction of the cross section the piers are 8.13 ft. wide, and in the direction of the nave are only 7.87 ft. This precaution was taken to give these piers a little m more bearing in the direction of the thrust of the vaults. Th The jointing of these piers is given by Villard of Honnecourt and is reproduced in our Fig. Villard of Honnecourt indeed t takes care to tell us that this jointing was arranged to conceal the joints of the drums; at is unnecessary to add that t the jointing alternates in each two courses. At the level of the triforium, at a b (see elevation B), the pier adopts the section C. The engaged column d is bonded with the structure, i.e., is built in courses, while the little columns receiving the diagonal arches of the great vaults, and the little columns receiving the side arches, are set on end, maintained by the bands g, h, that form rings, and the capitals i and l. T The architect of Notre Dame of Rheims did not yet have a very definite theory of equilibrium of vaults in the great Gothic edifices, and he believed that he must give his piers a very strong section, at the level of the triforium, he thought that he must erect a great buttress with overhang to support the piers receiving the flying buttress. (Art. Cathedrale, Fig. 14). The architect of the cathedral of Amiens was bolder; he gave a much smaller section to his piers, and thought of maintaining them in a vertical plane only by the aid of the flying buttresses.(Art. Cathedrale, Fig. 20).

Other constructors have tried twin columns in the cathedrals of Sens and of Arras (section D; 1160), or later columns with a single engaged column (section 8), or again columns of oval section, as in the choir of the cathedral of Seez (end of 13 th century; section F), as they were dominated by this idea of resisting the thrusts and of occupying the least area possible, not to obstruct the view of the naves and sanctuaries.

The examples of piers borrowed from the cathedrals of Rheims and Amiens only show us a great central column with 4 engaged columns; the little columns intended to bear the diagonal and side arches only spring above the lower capital. Already about the middle of the 13 th century the little columns of the diagonal arches of the great vaults were extended down to the base itself of the pier; then soon it was desired to carry t the diagonal arches and side arches on special shafts; the p piers then assumed the section given by Fig. 15; A being the side facing the great nave and B the part of the pier with regard to the side aisle. From the instant that it was admitted, that the diagonal arches, like the archivolts and transverse arches, must have their little columns ascending from the ground, it was logical to admit that the side arches themselves should possess their vertical supports, and even that the members of these vaulted naves should each have their special point of support. Then were multiplied the little columns around the central cylinder, and the mouldings themselves of t the arches came to die on the base of the pier. This system tended to suppress the capitals, for of what use is a capital as soon as the moulding forming the arch continues along the pier? Already about 1230, the little columns attached to the piers are no longer detached and monostylar, but belong to the same courses of the pier. In multiplying these little columns they become too slender to make it possible to cut them in a stone set on end, and even then it would have been very difficult without risking the breaking of the stones to cut out the reentran angles with the chisel, the junctions of the little shafts wit the nucleus, and these angles were rounded, as s shown in the section (Fig. 16). There resulted from that practical necessity a series of curved and soft surfaces, that o only gave undecided shadows; it was necessary to find on those surfaces stops for light, that could accent the principal ribs.

The architects then had the idea of reserving on the front of each little shaft the edge that caught the light, and accented the projection of the cylindrical rib. (See A, Fig. 16). It resulted from the adoption of this principle, that the little shaft being engaged tc the principal nucleus by a cove and h having a projecting rib, it passed from the cylindrical form to the prismatic form.

From the end of the 13 th century the school of Champagne, which from 1250 had taken the lead of the other Gothic schools, sought sections of piers that should be rigorously logical, i.e., that the clustered section should only have the arches supported by those piers. Then the section of the arches imperiously determined the sections of the piers, and to trace t the pier it was necessary to commence by knowing and tracing the different members of the vaults.

The men that erected the church of S. Urbain of Troyes about 1290 took from that epoch the radical system that we have just indicated; but one will easily understand that the accepted f form of the great cylindrical central pier could no longer a accord with this new system, the combination into a cluster of all the ribs of the arches no longer being able to be resolved into a cylinder, even by joining to it additions, as do done previously and as indicated in Figs. 15, 16. It was necessary to absolutely abandon the tradition of the great central column, which persisted until about the middle of the 13 th century. Carried onward by the logical progress of their art, the constructors of S. Urbain did not hesitate, and we see that in the same edifice and during a very brief time, (ten years at most), they frankly reached the prismatic pier by suppressing the capitals.

Fig. 17 presents at A one of the 4 piers of the crossing. This pier bears two transverse arches B of the great vaults, two archivolts C of the side aisles, the branch D of the vault of the crossing, two members of the diagonal arches of the high vaults, and the branch F of the diagonal arch of the vault of the side aisle. Its plan takes the form given by the profiles of these 8 arches, and places the points of support vertically under the trace of the imposts of these arches. T The first pier of the nave, whose section is given at G, indicates likewise the horizontal projection of the imposts of

the archivolts B′, of the diagonal arches E′ of the great vaults, and of the diagonal arches E″ of the vaults of the side aisles, as well as those of the transverse arches H of the g great vaults and I of the low vaults. Their piers also bear the capitals in a very low course, because the profiles of t the arches of the vaults are identical with the sections of t these piers. But the second pier of the nave gives the section K and is traced in such manner, that the archivolts L, the t transverse arches H and I, the diagonal arches M exactly penetrate that section, the members a following at a′, members b at b′, c at c′, d at d″, etc. But not to weaken the pier by hollows, the coves, hollows and profiles meed the solid surface e′, the sharp edges f of the rounds being marked on the p pier by the edges f′. Hence the capitals are suppressed. A s similar experiment, dating from the last years of the 13 th century, does not fail to be of great interest, when one sees that also during the 14 th century in the provinces of Ile-de-France and Normandy, men adhered to sections of piers not entirely marking the section of the arches of the vaults, and consequently requiring the use of the capital to separate the imposts from the group of little columns of the pier.

The church of S. Ouen of Rouen, whose choir dates from the 14 th century, presents piers traced according to section G, i.e., that project with some modifications the transverse and diagonal arches of the vaults, and that still possess capitals; it is only at the end of the 14 th and the beginning of the 15 th centuries, that the method adopted by the architect of S. Urbain of Troyes is definitely accepted, and that the piers are only the combined and grouped projection of the different profiles of the arches. But since that method, however rational it was, required labor and consequently considerable expense, at that epoch men often returned to the cylindrical pier, into which then penetrated the profiles of the different arches of the vaults. Thus were constructed the piers of the lower church of Mt. S. Michel-en-Mer, and of a great number of edifices built from 1400 to 1500, particularly in civil structures, when it was claimed that useless expense was not incurred. However one should not lose sight of this fact, that from 1220 the French architects, renouncing the cylindrical column for supporting vaults, constantly sought to transform that column

into a support of the projecting members constituting the vault, and consequently into a vertical group of those members. The pier daily tended to become merely the continuation of t the arches of the vaults, and we see that from the end of the 13 th century, men had already arrived at that result. The p pier being only a vertical cluster of the arches of the vaults, properly speaking, it was no longer a pier, but a group of ar arch mouldings descending vertically to the ground, i.e., the trace of the lower bed of the imposts that formed the horizontal section of the pier, and indeed this force is so important in vaulted edifices, we may say so imperious, that it must necessarily lead to this result. From 1220 Gothic architects could not erect a vaulted monument without previously tracing the plan of the vaults and of their imposts; it was very natural to regard this trace as the trace of the plan on the ground, and of placing these imposts on the base of its construction; this was a means of economizing drawings, and particularly for avoiding errors in location.

In civil architecture the piers assume forms that are no less the expressions of the necessities of construction, either w when they bear vaults or they support the floors. Thus in the lower stories of the palace of the bishop of Meaux, stories that date from the end of the 12 th century, we see piers placed in a row to carry the double vaults, and whose construction is quite remarkable. Here (Fig. 18) is their horizontal section at A and their elevation at B. The vaults have no t transverse arches. These are cross vaults built like the Roman vaults, with a simple round in relief on the groins and an obtuse angle in the place ordinarily occupied by the transverse arch. (See section C made on a b). The pier consists of a principal cylindrical body with four cylindrical rounds (see section A); the piers are monolithic from the base to the astragal of the capital.

Houses of the city of Dol still possess monolithic piers of granite that date from the 13 th century. They bear wooden g girders and form porticos or side piers of shops. Here (Fig. 19) are two of those piers. At A is the section of the pier A and at B is that of pier B. Architects always sought with reason in cutting those isolated or engaged piers to avoid sharp angles, that break easily and are very troublesome. It

suffices to walk any day with the crowd in Rue de Rivoli at Paris. to recognize the inconveniences of the angles left on the isolated piers; they are so many injurious edges placed before passers. Admitting that this may be monumental, it is no less inconvenient.

The architects of the end of the 15 th century not only carried down the piers the prismatic profiles of the groins of the vaults, but they also sometimes pleased to twist them spirally and to decorate by carved ornaments the intervals left between the sides. One sees a curious pier cut thus a the b back of the chevet of S. Severin at Paris. Also ne sees one composed of great spiral rounds in the church of S. Croix of Provins. These are caprices that cannot serve as examples and that nothing justifies. The province of Normandy furnishes more than one of these oddities due to caprice of the artist, who at the end of his resources, seeks in his imagination combinations adapted to surprise the public. The masters of the middle ages never had recourse to such fantasies. Only in England from the 13 th century started this desire to produce surprising effects. Already in the cathedral of Lincoln are seen piers of that epoch, composed with a search for petty effects, that is only found much later in our school. Examples of piers are presented in Arts. Architecture Religieuse, Cathedrale, Construction and Travee.

PINACLE. Pinnacle. Terminal.

Crown or termination, as said in the 14 th century, of a b buttress, a vertical support more or less decorated and ending in a cone or pyramid. In monuments of high antiquity, one already finds certain endings of the angles of pediments and of cornices, that are actual pinnacles.[1] Most of the monuments of our Romanesque period have lost nearly all the upper terminals that recall that antique tradition. Yet the ornaments in form of pine cones that terminate the lanterns of the church of S. Front of Perigueux, may pass for actual pinnacles. It is only in the 12 th century that one begins to note numerous remains of this sort of terminations. Then they surmount the angles of square towers at the bases of cones or pyramids forming t the spire; they appear above the buttresses at the angles of gables. At first little developed or in form of little struct-

structures, from the end of the 12 th century they assume very great importance; then at the beginning of the 13 th century, they frequently become actual monuments. Like all architectural members of that time, pinnacles fulfil a function; they are destined to ensure the stability of vertical supports by their weight; they maintain the overhang of gargoyles and upper cornices; they preven the sliding of the copings of gables; they serve for attaching balustrades; but also their outlines, always composed wit infinite art, contribute to give to edifices a special elegance. Sometimes during the Romanesque period, t these are very simple terminations. The buttresses of the 11 th and 12 th centuries, for example, in Beauvoisois, are often terminated at their tops by a cone rounded at the vertex. These cylindrical buttresses thus present termination reproduced in Figs. 1 and 2.[1]

Note 1.p.176. See the medal struck in the reign of Caracalla giving on the reverse the temple of Venus at Paphos (bronze); that giving on the reverse the temple of the Sun at Baalbec. Consult Architectura numismatica, collected by Donaldson, architect. (London. 1859).

Note 1.p.177. The pinnacle of Fig. 1 comes from one of the buttresses of the great church of S. George (12 th century). That of Fig. 2 is found on some edifices of Beauvoisois of t the end of the 11 th century. The pinnacles crowning the cylindrical buttresses of the church of S. Remi of Rheims were terminated by analogous pinnacles. (11 th century).

The Collegiate of Poissy still retains on one of the angles of the stairway of the apse terminated by an octagonal pyramid, a pinnacle from the beginning of the 12 th century, and which we give a perspective drawing (Fig. 3). This pinnacle consists of four little columns supporting a group of capitals cut in the same course; a cone terminated by a cross-flower c crowns the capitals. This pinnacle is very small, about 4.3 ft. high; it is found frequently adopted in the edifices of that epoch at the bases of the pyramids of spires. The old t tower of Chartres has at the angles of the tower at the springing of the spire,pinnacles of beautiful composition, which at the same time serve as dormers (Art. Fleche, Fig. 4); these date from the middle of the 12 th century).

The keeps of the castles also nearly always possessed their

pinnacles, probably from an early epoch, if one refers to vignettes of manuscripts and to the engraved representations of those edifices that remain to us. In the 12 th century we again find some in place or in fragments. Sometimes even, as at the tower of Montbard, they are directly placed on the merlons of battlements. At the keep of Coucy they were four in number, built on the thick slope that covered the cornice of the upper defense. (Art. Donjon, Fig. 39). But the brilliant epoch of pinnacles is that when the architects began to erect flying buttresses to abut the great vaults of the naves of their c churches. It was necessary on the buttresses receiving these flying buttresses to add a load, a vertical pressure intended to neutralize the oblique pressure of these arches, and to b permit diminishing the horizontal section of the abutting piers. (Art. Construction). However powerful were these piers, the flying buttresses exerted their thrust near their tops, and if these tops were not loaded, could cause the last courses to slip. There was then necessary above the start of the arch a vertical load, a pressure. The architects of the lay school very quickly understood the benefit, tha they could derive from this need, from the point of view of the decoration of edifices, and they did not hesitate to imagine the most beautiful and graceful combinations to satisfy this part of the programme imposed on constructors. They knew now to compose pinnacles, sometimes very simple for edifices built at small expense, sometimes very rich, but always understood in a remarkable fashion in outline and construction.

Among the most beautiful pinnacles that we possess in our French edifices of the 13 th century, it is necessary to cite in the first line those terminating the buttresses of the catedral of Rheims. These are actual masterpieces of composition and execution. One conceives how difficult it is to place little structures at the top of a monument, and to subject t them to the scale adopted for the entirety. While giving an extreme elegance to these crownings, the architect of Notre Dame of Rheims knew how to place them in perfect harmony with the enormous masses near them, and that in accompanying them by c colossal statues, which present along the entire length of t the nave and choir a continuous series of grand motives filling the eyes, and causing to disappear whatever of thinness

there might be in these open and indented pyramids.

Here (Fig. 4) is a perspective drawing of these pinnacles. The calmness and simplicity of the composition have no need t of comment to be appreciated; the sketches that we give, so far as they may be from the original, emphasize the essential qualities of the work. Note how in this purely decorative detail the architect has known how to avoid commonplaces. In the ornamental parts of the architecture, from the epoch of the Renaissance and more particularly in our days, men have so w well known how to familiarize our eyes with what we term the botches of our art, that we have lost the feeling of what is true, of what is in its place, of what is decorated because of the place and the purpose. What do we see here in that immense ornamental appendage, that has no less than 73.7 ft. from the gargoyle to the upper cross-flower? 1, a pier or strong abutment, solid from A to B, intended to abut the thrust of the l lower flying buttress, whose oblique pressure acts with more energy than the second; 2, from B to C an opened pier, sufficien to abut the thrust of the second flying buttress, on condition that this open pier is loaded by a considerable weight, that of the pyramid C D; 3, before the open part of the buttress are two monolithic columns, that stiffen the entire system of the structure, and beneath that open part intended to give lightness to that enormous pier is a sheltered statue, composed in such manner, that the lines of the wings break t the uniformity of the vertical lines; 4, the weight of the p pyramid is accented to the eyes by the four corbelled angle pyramids. In all that is nothing superfluous, nothing not j justified or calculated. In all parts the construction is perfectly in accord with the decoration and the object; further a wise construction, in part contradicting the form.

The architects could not always dispose of resources so considerable, or allow themselves to erect before the buttresses or on their tops small structures of this relative importance. On the contrary, we frequently see that they are without the means for completing their work. At the cathedral of Chalons, the architect proceeded with evident economy. Thus the pinnacles terminating the buttresses of the nave (Fig. 5) are very far from presenting the richness and abundance of composition of those of Notre Dame of Rheims. They consist of a small pyr-

pyramid of octagonal section surmounting the head of the buttress ending in three gablets above the gargoyle receiving the water from the roof running in the channel A forming the coping of the flying buttress. Here the abutting pieces rise in one line to the level B; this pinnacle is no more than a simple crowning destined to cover this pier and to lighten its summit. Such a restricted programme being given, these pinnacles are skilfully treated, and it is difficult to pass from a massive base to a slender terminal with more skill.

The buttresses of the cathedral of Rouen above the chapels of the nave on the north side show beautiful pinnacles dating from about 1260. They consist (Fig. 6) of a little structure having in depth twice its width, the rear part is solid and reses as an abutment for the flying buttress, the front part is open and rests on two little columns. Beneath the canopy formed by the front gables is placed the statue of a king; t the enclosing walls of the chapels are at A. Assured of the quality of the materials that they selected, and knowing how to employ them i accordance with that quality, the architects of that epoch did not recoil from this boldness. These pinnacles are now 600 years old, and certainly have not been maintained with much care, are still standing, and their slender columns support their canopies without having suffered alterations. One sees a pinnacle similar to these at the head of the first northern buttress of the choir of the cathedral of Paris, exceptionally rebuilt about 1260, and containing the grouped statues of the three Magi kings. Those of the abbey c church of S. Denis erected at the heads of the flying buttresses in the reign of S. Louis, originally recalled this system; but they have been so disfugured by the restorations undertaken 25 years since, that one cannot recognize them. An o octagonal turret surmounted the double bay of the gables.

The 14 th century went farther in the matter of lightness in the composition of pinnacles. Those of the cahpel of the Virgin of the cathedral of Rouen are of a slenderness, that makes them resemble articles of jewelry, and they seem rather executed in metal rather than in stone; it is true that the stone selected, that of Vernon, lends itself marvellously to these refinements.

As in all other members of Gothic architecture, the pinnac-

pinnacles adopt vertical lines by preference to horizontal lines, as they are more distant from the beginning of the 13 th century. Thus (fig. 7) the pinnacles that terminate the buttresses of the s-chapelle of the palace at paris sketched at A rest on the cornice that extends entirely around the edifice, and their gablets start from the horizontal slab a placed on a cupe decorated by sunk panels. Those of the hall of the synod at Sens, built at the same epoch, i.e., about 1260, and all different, also accint the horizontal lines that intersect the verticals. At B we give that accompanying the statue of the king S. Louis, that represents a keep with portal closed by a portcullis, grated windows and turrets. The horizontal section of this pinnacle at the level c d is shown at B'. The pinnacles crowning the buttresses of the choir of lhurlh S. Urbain of Troyes drawn at C, whose horizontal section at the level a b is sketched at C', have as a horizontal member only a band marked by the little lower pyramids. These pinnacles date from 1290. Finally, the great pinnacles that rest on the ends of the flying buttresses of the choir of the cathedral of Paris, represented at D and that date from 1300 scarcely accent the horizontal line. Likewise, the architect evidently desired to give to that impartant architectural member a slender appearance. The turret f attached to the principal body of the pinnacle, and that abut it, lead the eye to the point e of the s summit by an almost unbroken line. These pinnacles are very skilfully composed and produce a grand effect. The channel t that serves as a coping for the flying buttress conducts the water through the sides of the upper turret into a great gargoyle placed at its base. These four pinnacles are drawn at the same scale.

In the 15 th century the horizontal line not only no longer enters into the composition of pinnacles, but also these usually form a grout of pyramids terminating in pyramids, intersecting and some extending above the others. Among the pinnacles of that epoch, whose execution is good, we shall cite their section made on a b, and at B some details quite remarkable in their execution.

The outline evidently occupied the architect authors of these conceptions, and it is certain that with rare exceptions, it is happy. These architectural members are almost always de-

detached against the sky, and we have indicated in other Articles (Arts. Clocher, Fleche) the difficulties presented by the composition of a terminal having the atmosphere for a b background. In desiring to avoid meagreness one easily falls into the opposite excess; the least defect in prportionn or in harmony of the details and the entirety shocks the least experienced eyes, destroys the scale and makes a spot; for t the sky is a formidable background for architectural works; t thus it is necessary to see with what care the architects of the middle ages have studied the parts of their edifices, whose outlines are free from anything in the vicinity, and how the architects of our time fear to expose their works outlined on the atmosphere. Several have declared that such boldness w was in bad taste, that was an easy means of evading the difficultn, and yet nine times out of ten, monuments are detached in outline agains the sky, for they rise above private structures, and are rarely in full light, especially in our climate. Indeed it is necessary to consider, that it is particularly in provinces situated north of the Loire, that pinnacles assume great importance and are studied with minute care.

The 16 th cen ury also composed quite beautiful pinnacles, but which one cannot compare to these of the 15 th century in boldness, nor in harmony of details with the entirety of proportions. The pinnacles of the 16 th centurw are habitually b badly joined to the part that they crown, and they are not c connected with that marvellous skill, for example, that we admire in the composition of those around the choir of Notre D Dame of paris. These are works no longer belonging to architecture, little structures planted on the buttresses, without any connection with the building. They no longer fulfil their essential function, which is to ensure the stability of a point of support by a load acting vertically, they are ornamental appendages, the remains of a tradition, whose motive no longer is understood.

PISCINE. Piscina. Lavatory.

Bowls ordinarily constructed at the left of the altar (epistle side) in which the celebrant made his ablutions after communion. Dr. Graneolas [1] thus expresses himself on the subject of piscinas:- "There are two sorts of ablutions after the com-

communion, the firs is that of the chalice, and the second is that of the hands or fingers of the celebrant. The deacon made that of the chalice, as appears from some old missals, and the priest washed his hands. This being for the third time before coming to the altar after the offering, and after the communion like the said Ratoldo, having washed his hands the third time. In the Roman order of Gaiet, the priest did not swallow the wiye with which he washed his fingers, but poured it into the piscina. -- Yves of Chartres states that the priest washed his hands after the communion. Jean d' Arsomohes orders that there be a special vessel in which the priest washes his hands after the communion. In the customs of Citeaux, wine is placed in the chalice to purify it, and the priest goes to wash his fingers in the piscina, they he swallows the wine that was in the chalice, and takes some of it a second time to again purify the chalice.

Note 1.p.187. Les anciennes liturgies. Vol. 1.p.622. Paris. 1697.

I shall add that Leo IV, in a synodal oration to the priests, orders that there be two piscinas in each church, in the sacristies or near the altars:-- (Latin text). This was for washing the hands after the communion. Ratherius, bishop of Ravenna in his instructions orders the same thing; S. Uldarico (or Udalric) in the old customs of Cluny speaks of two piscinas; in one the chalice is purified, and in the other are wa washed the hands after the sacrifice; the deacon and subdeacon also wash their hands." Lebrun of Merettes in his Voyages liturgiques says, with regard to the practice at the cathedral of Rouen after communion:-- The priest after the communion makes no ablutions; but only while the ministrants at the altar communicate from the chalice, an acolyte brings another vessel to wash the hands of the priest, as done today at Lyons, Chartres and among the cistercians, and as still done at Rouen b before the last century, so that he was not obliged to rinse his fingers."[1] And further:- [2] "The last ablution with water and wine was not made then (in the 17 th century), and the p priest was not compelled to drink the rinsings of his fingers. He went to wash his hands at the piscina or lavatory, that was near the altar (the priest went to the lavatory). The same th thing is marked in the missal of the carmelites of the year

1574. And the ritual of Rouen desires that such may be near a all altars.". William Durand [3] says that near the altar should be placed a piscina or a basin in which the hands are washed. Abbe Grosnier in the Note published in the Bulletin monumentale,[4] proposes these different questions, that he seeks to s solve:- "1, has the priest always made ablution at the end of the service of the mass? 2, Was the discipline of the Church uniform on that point until the 13 th century? 3, was it modified at that epoch, and who was the author of the modification? 4, What is the origin of the double piscina observed in nearly all the churches of the 13 th century? 5, has the custom of making ablutions been universal and without exception?" Until the 12 th century the priest washed his hands in the piscina at the end of the holy mysteries. We have just seen tha t according to an old custom of Rouen, the priest could make no ablution; that was poured into the piscina while the ministrants communicated under the form of wine.

Note 2.p.187. Voyage liturgiques, by the Lord of Mouleon. ((Lebrun des Corettes). Paris. 1718).

Note 3.p.187. This rinsing was probably cast into the piscina.

Note 4.p.187. Rational des divins offices. Book I. Chap. 29.

Yves of Chartres expresses himself thus on the subject of a ablutions:- "After having touched and taken the sacramental kinds, before turning toward the people, the priest must wash his hands, and the water is cast into a sacred place destined for that purpose." "Yet," says Abbe Grosnier,[5] "by respect to the holy kinds, already before the 13 th century, one finds in the religious orders the custom of making ablutions; it a appeared inconvenient to pour into the same piscina the water that had served for washing the hands before the preface, and the liquid employed for cleaning the chalice and the fingers after the holy mysteries; thus one finds in the old customs of Cluny three ablutions made by the priests after the communion, one for the chalice and two for the hands."

Notes 4, 5. p. 188. 1849. Vol. V. of second series. p.55.

Pope Innocent III having decided that the ablutions must be made by the priest; "it has been desired," adds Abbe Crosnier, "both to retain the ancient customs, and to take into account, if not the decision of the Pope, at least the motives that incited him. Two piscinas a e established, one reserved for the

ablutions properly so called, and the other destined to receive only ordinary water."

Indeed, dating from the end of the 12 th century twin piscinas are seen to be adopted in the chapels of the cathedral and monastic churches, more rarely in the parish churches. The twin or single piscinas disappeared about the 15 th century, when the custom of drinking the ablutions was adopted in all churches.

Perhaps before the 12 th century, there were portable piscinas, metal basins placed near the altar, for it is only after that epoch, that the piscina is seen to form a part of the edifice, that it is foreseen in the construction, also the first piscinas appear to be extras, appendages not a cording with the architecture, while in the 13 th century the piscina is d designed in the view of harmonizing with the entirety of the structure.

The apsidal chapels of the abbey of S. Denis, which date f from Suger, have single piscinas in form of a basin attached to a pier. At the end of the 12 th century, in the chapels of the abbey church of Vezelay we see piscinas conceived after t the same principle and that form an appendage. Here (Fig. 1) is one of them composed of a lobed bowl with orifice at the centre. The bowl rests on a group of little columns pierced vertically, so as to lose the water in the foundations. This was the custom generally adopted after the arrangement of the first piscinas, to lose the water under the ground itself of the church. Later the piscinas were furnished with gargoyles casting the water outside on the consecrated ground surrounding the churches. This piscina of Vezelay rests on the bench that extends around the chapel and receives the arcade; its bowl is alternately decorated on the exterior by flutes and rounds; the base, the group of the four little columns and the bowl are cut in a single blo k of stone. In the church of Montreale, which dates from the same epoch, behind the main altar and in the same bench that receeves the arcade, is hollowed the bowl of a piscina (Fig. 2) of a square form. Thus the bench serves as a shelf for depositing the vessels required during the ablutions. Later the piscinas assumed a certain importance, and were made in the form of niches made in the walls of choirs or chapels. The use of the piscina was thence-

thenceforth consecrated, the more because the single bowl was replaced by twin basins. One finds many piscinas of this kind from the end of the 12 th century. They take the form of double niches separated by a little pier, and in the slab of which are hollowed two basins of square form, or more commonly circular, with an orifice at the centre leading into the foundations.

Many abbey churches of that epoch, of the orders of Cluny and of Citeaux retain in their chapels piscinas so arranged. That which we give (Fig. 3) comes from the abbey of S. Jean-les-Bons-Hommes, A little isolated pier receives an impost b bearing two round arches. There is seen at A a recess made for inserting a wooden shelf; at C is a recess terminated at the right end by an orifice. Perhaps that recess was intended to receive a hollow reed. Indeed Lebrun of the wariettes in his Voyages liturgiques,[1] relates that still in his time, there was in the abbey church of Cluny a little altar at the left side of the great altar; that the little altar served for the communion in both kinds, which was practised on feasts and S Sundays for some ministrants at the altar. He adds "that after the celebrant had taken the sacred host and a part of the blood, and he had communicated the host to the ministrants of the altar, they went to the little side altar, and the deacon having brought the chalice, accompanied by two candlesticks, he held the silver reed by the middle, the end being at the bottom of the chalice, and the ministrants of the altar, having one knee on a little upholstered bench, took and drank t the precious blood through the reeda The same thing was practised at S. Denis in France on solemn days and Sundays. That little altar was called the Prothese."

"After the communion," says Boquillot, "the reed was placed in the ambry with the chalice; now the traces of fastenings v visible in our Fig. 3 at B, indicate that a closure was arranged to close this piscina, which thus became an actual ambry; the chalice might have been placed on the shelf whose groove is seen at A. A little later near the piscina was often constructed an ambry. (Art. Armoire). Thenceforth it was unnecessary ts close the piscina, thus we see that from the beginning of the 13 th century, they are arranged to be open, although they most frequently may be arranged in twin niches.

Note 1.p.191. Voyages liturgiques, by Lord Mouleon. p. 149.

The pretty church of Villeneuve-le-Comte retains in the S. chapel a piscina of this kind very delicately composed. It co consists of a niche separated in two parts by a pier, like t the two jambs, cut from one block of stone. The twin arches are hollowed out of two stone slabs, the construction enclosing it around. The bowls are circular (see plan), and no trace indicates that this piscina was ever closed. The little detached columns are no more than 1.6 ins. diameter. One already sees by this example, that the architects of the 13 th century, once that the programme of the piscina was adopted, made it a motive of decoration; in fact they admitted that a need or requirement might become the object of a special study, a and consequently a means of ornamenting the edifice. We shall seek today to disguise this appendage in order not to oppose the lines of the beautiful architecture, our ancestors on the contrary caused it to appear frankly, although it was never on an axis, and decorated it with care. The chapels of the c cathedral of Amiens, erected about 1240, possess beautiful piscinas placed in the arcade forming the substructure; treated with a particular care, these principles are placed at the left of the altar (epistle side) according to custom. On the side opposite is constructed an ambry.

We give (Fig. 5) a perspective of the entirety of one of t these piscinas with the arcade accompanying and enclosing it. Fig. 5 bis gives its plan. As one sees by the plan, the little columns of the arcade are independent of the piscina, which is made at the expense of the thickness of the wall of the substructure. The orifices of the two basins are lost in the foundations, those piscinas having no external gargoyles.

The S. Chapelle of the palace at Paris likewise presents at the left of the main altar a very beautiful piscina with double bowl, with a credence above divided in four compartments. This piscina is engraved in the monograph of the S. Chapelle published by M. Calliat;[1] like that just given it combines with the arcade forming the decoration of the substructure of the chapel. Opposite at the right of the altar is a double ambry.

Note 1.p.193. Bance. Paris. 1858.

Sometimes, but very rarely in the churches of the 13 th century, the piscinas are made in the form of basins set on a p

pedestal, like those of Vezelay. We shall cite those of the chapels of the choir of the cathedral of Seez (end of the 13 th century), a sketch of which we give (Fig. 6). Here the two bowls do not have the same form, one being polygonal and the other round, they rest on a group of leafy branches, and are placed in the openings of the arcade. The clusters of branches spring from the continuous bench serving as a base for that arcade.[1]

Note 1.p.19m. There is always a bench before the piscinas.

The piscinas of the chapels of the 13 th and 14 th centuries of the cathedral of Paris are very simple, and only consist of a small lobed niche on two little engaged columns; or falling on the slab by a chamfer. All these piscinas have gargoyles on the exterior. The piscinas of the chapels of the choir of the cathedral of Rheims were closed by wooden shutters and at the same time served as ambries.

The 14 th century made very delicate piscinas, richly carved. We shall cite among the most remarkable those of the choir of the church of S. Urbain of Troyes.[2] It contains two bowls separated by a middle pier and terminated by two gables decorated by being crowned by the Holy Virgin and by two little figures of the two givers, Pope Urbain IV and cardinal Aucher. Two canopies treated artistically crown these little figures and are surmounted by merlons between which appear archers serving to defend the little structure. This piscina is very well engraved in the Annales archaeologiques,[1] after a drawing of M. o Boeswilwald, and be believe theer is nothing better than to send our readers to that reproduction and to the Note of M. Didron accompanying it. The piscina of S. Urbain is not the only one crowned by crenelations; we will cite also those of the apsidal chapels of Semur-en-Auxois, that are sixty years earlier than those of S. Urbain, and are likewise crenelated at top.[2] Piscinas became rare in the 15 th century, probably because the custom of drinking the ablutions was generally a adopteda Still we find some examples of them, but the double bowls are no longer used. In one of the lateral chapels of t the church of Semur-en-Auxois exists a pretty piscina of the 15 th century that we give here (Fig. 7). The bowl is supported on a little column, and in the niche made over it is a little shelf for placing the vessels. A very rich canopy surmounts

the whole. At A we give the section of this piscina on a b' at B on c d. One further sees in the French churches of the 13 th and 14 th centuries a prodigious number of piscinas entirely varied in the form of a charming composition. In these accessories can be observed the singular fertility of the architects of this epoch. They very rarely reproduce even a remarkable example; with a collection of piscinas, one would make an entire work furnishing compositions infinitely varied for the same object.

Note 2.p.195. This piscina dates from the last years of the 13 th century, but by its ornamentation belongs to the 14 th century. We have several times had occasion to state that the church of S. Urbain of Troyes is at least 25 years in advance of the architecture of Ile-de-France.

Note 1.p.196. Volume VII. p. 36.

Note 2.p.196. One of these piscinas was engraved in Annales archaeologiques. Vol. IV. p.87. These piscinas have a single bowl. In the lateral chapel of the church of S. Thibaut is a also seen a piscina of the 14 th century with a single bowl, crowned by a crenelated canopy.

PLAFOND. Ceiling.

What we term ceiling today in our structures, i.e., those level beams lathed and plastered beneath so as to present a plane surface, did not exist, because the ceiling was only t the appearance of the real construction of the floor, composed of visible girders and beams, more or less richly moulded and even carved. These ceilings thus show projecting and recessed parts, sometimes forming coffers or panels, that were decorated by mouldings and paintings. There remain in France no ceilings earlier than in the 14 th century, although we know perfectly that some existed before that epoch, since they made floors that were not plastered underneath. The plastering applied on laths under the floors indeed have the serious inconvenience of depriving the wood of the air necessary for its preservation, of heating it and causing decay. Wood left in dry air can exist for centuries, enclosed in a layer of plaster, especially if not entirely dry, heats and ferments, and is reduced to dust. We do not think it necessary to insist on this fact so well known to practicians.[1]

Note 1.p.198. On the contrary the use of floors in iron justifies the adoption of plane and plastered [illegible] smooth.

Then the ceiling in the middle ages was only the floor; the construction of the floor gave the form and appearance of the ceiling; the idea never came to the masters of that epoch to cover the underside of a floor by vaults, panels and coffers of wood or plaster with no relation to the combination given by the real construction. It would thus be difficult to treat of the ceilings of the middle ages without likewise treating of the floors, since one is the consequence of the other; so we shall combine these two Articles in a single one.

If the rooms were narrow, if between the walls existed only a distance of 6.6 ft. or 9.8 ft, men were contented by simple joists wit ends resting on a stone projection, in holes or on wall beams; but if the room were wide there were first placed girders with strength capable of supporting the weight of the floor, then joists were laid on those girders. This method was adopted in Roman antiquity and it was followed until in the 1 16 th century. When the girders had very great spans, they did not commit the fault of trussing to stiffen them, to prevent their bending under the weight of the joists. It is clear that such floors would occupy much height' but our ancestors did not fear the projections of girders, and even regarded them as a means of decoration.

The girders (Fig. 1) generally had little bearing in the w walls, but were relieved by stone corbels projecting more or less. If these girders were ornamented by mouldings on their angles, these only appeared beyond the part resting on the c corbels. In the oldest floors, the joists rest only one end on the girder, as shown at B; the other is in a rece s made in the wall, in holes, or on a wall beam C, which is itself placed on little corbels or on a continuous moulding. As it frequently occurs that these joists tip, being held neither by tenons nor by pins, so that one places blocks E between them on the girder and the wall beam, cut like keys and pinned obliquely. This means greatly stiffens the joists and girder. The spaces between the joists were anciently filled solid or left open, were plastered on boards, or indeed were well covered by boards G running crosswise. The joints of these boards were masked by battens H, which formed as many little panels

between the joists. On these boards was laid a surface of plaster or mortar and then the tiles K. The wood of these ceilings rarely remained visible; it was generally covered by distemper painting, that could easily be renewed. One still sees a good number of those ceilings of the 13 th and 14 th centuries under more modern laths in old houses. Sometimes the girders and the joists themselves were delicately moulded.

This system of floors employed a great quantity of wood and required joists of large dimensions; for as we have already stated, these joists were as often set solid as spaced apart; they lent themselves perfectly to covering long rooms, great corridors and galleries, but for chambers, rooms nearly square, it did not offer the stiffness, that was sought in rooms muct occupied and furnished with heavy furniture. Thus in the 14 th century men endeavored to replace this so simple a system by another with a more pleasing effect, presenting more stiffness. Thus (Fig. 2) a hall being given, whose quarter is traced in A B C D, two principal girders E were placed. Four lines of beams F formed cross beams and were framed into those girders, and joists G were likewise framed into the beams. At H we give the section of this floor made on a b. The beams rest at the walls on corbels I, the wall beams K are set in a recess, fill the intervals between the beams and receive the ends of the j joists. The junctions of the timbers of this ceiling are sketched at L. The girder is profiled at P with the support of the beams at M. Those at N have a dovetail tenon that fits in the gain M, and gains R receive the dovetail tenons S of the joists. Planks 1.5 ins. thick were placed on the joists and held by r rebated stops T. This system of dovetailed joints gave much stiffness to the floor, prevented the separation and housing of the timbers. The moulded beams formed a series of panels of very rich and pleasing appearance. We have seen ceilings so constructed in the houses of the little cities of S. Antonin and of Cordes, that have suffered no alteration. These ceilings in beautiful oak or even fir, were never decorated by p painting and present woodwork of a beautiful color. Not content with decorating them by mouldings, the architects then e enriched them by carvings. There exists in a house at No. 1, Rue du Marc at Rheims a magnificent ceiling in carved wood of the 15 th century, conceived on this principle, and which is

as much a work of joinery as of carpentry.[1] It covers a hall 49.2 ft. long by 21.3 ft. wide, and is divided in 5 bays separated by 6 girders, the two end ones forming wall beams. Fig. 3 gives a part of one of these bays, the entire ceiling being sketched at A. Between the girders D are placed the beams C with tenons at their ends. The beams are stiffened by the cross beams E. Panels B fill the intervals. These panels are decorated by (forms of)folded parchments. The girders are carved on their sides and beneath: corbels are placed under the ends of the beams.

Note 1.p.202. M. Thieret, architect at Rheims, was very willing to draw this ceiling for us with the greatest care.

Details are necessary to explain the connections and decoration of this ceiling; we give them in Fig. 4. At A is drawn the half section of the girders; the dotted line a indicates the span of the beam B. The corbels C have their abacuses fixed at b under that span. The cross beams D stop at the beams as indicated by the perspective sketch D'; a slightly inclined shoulder E receives their ends. At G we give a section of the beams with the end of the girder near its span. Assuming the beams removed, the girder presents the sketch H. Thus one sees that the corbels are independent and allow the passage behind their bottom, of the mouldings sculptured on the girders. This detail explains very well how the ceiling, partly carpentry and partly joinery, presents stiffness; its appearance is pleasing without attracting the eyes too much, which is important, for the architects of the middle ages and even those of the Renaissance did not yet think of those compositions, majestic in some eyes, grotesque in those of others, by which were covered the ceilings after the 17 th century, compositions that on the whole are nothing but plastering on laths, painted and gilded, fastened by iron cramps, appearances masking great poverty of means beneath a covering of applied casts, simulating marble and bronze, sometimes even tapestries!

In the construction of their floors and consequently of their ceilings, the masters of the middle ages were always truthful; they exhibited and adorned the construction. We think that there was more merit in that, than to deceive [illegible] by principles of construction. They first occu-

occupied themselves with the combinations of timbers in carpentry, they sought to ornament them according to that combination.

In the southern provinces of France were also employed ceilings applied and nailed on the beams; i.e., beneath the joists were nailed boards, on those boards being fixed mouldings forming panels decorated by paintings. This sort of ceilings was very rich, and at the same time presented the lightness that the eye likes to find in the upper parts of a room. This procedure was again employed during the Renaissance, and the ceiling of the gallery of Francis I at Fontainebleau gives a charming example of it.[1]

Note 1.p.204. This ceiling has unfortunately been repaired. We speak of that whice existed before 1843. At Venice are still seen beautiful ceilings executed on this system. One likewise finds such in Spain and especially at Toledo. The mansions of Toulouse presented some of them a few years since.

Our century is a little too strongly permeated by the conviction, that it invents daily, does not doubt that ceilings c composed of brick vaults set on wooden timbers or iron beams are an innovation; now here is (Fig. 5 at A) a ceiling placed in a house built at the end of the 15 th century at Chartres, Rue S. Pere, which gives us a combination of this kind. The beams B are set on an angle and fixed in the walls, on their flat sides b are turned brick vaults set diagonally. These bricks are 1.64 × 3.23 ins. The spandrels C are filled by masonry on which rests the tiles d. The beams are 1.05 ft. square, and being set diagonally, present great stiffness. This ceiling of very small span produces a very good effect, and can e easily be decorated and kept clean. At Troyes in the mansion of t the Eagle, called du Mauroy, Rue de la Trinite, exists a ceiling of the 15 th century entirely of wood (see sketch G), which presents beams E set diagonally according to Fig. 5. In t the reentrant angles formed by these adjacent beams are nailed triangular strips I, and then across all the planks K. These beams are framed into girders, whose half section we give at L. Sometimes the salient angles of these beams are chamfered, which gives the ceiling an uncommonly light appearance. The fashion of the majestic (for the majestic is one of the most permanent fashions in this country, that changes them so fre-

freely) has destroyed or covered with laths many of these ceilings of the middle ages or the Renaissance. It is necessary to follow the demolitions of our oldest mansions to discover under the plastering combinations often very ingenious. Thus for example, at the demolition of mansion de la Tremouille at Paris, we saw under the laths covered by plaster mouldings on beams very delicately wrought, set on girders and forming a series of graceful panels. That was a combination analogous to that given in Fig. 3, except that the cross beams were connected at one-third the depth of the beams and left spaces p perfectly square. Each interval was filled by a panel carved in arabesques; the whole had been painted and gilded. England is more conservative that we are in regard to its old edifices, (which does not preven it from being at the head of progressive ideas), and still possesses beautiful ceilings of the 15 th and 16 th centuries, in moulded and carved wood. If the s spans of the girders were very great, they were often trussed, i.e., composed of two tiebeams holding two inclined timbers, or surmounted by two actual principals included in the depth of the joists and tile floors. Stirrups of wrought iron suspended the girder from the two principals; these stirrups contributed to the decoration of the girder, and the mouldings cut on the visible angles stopped at the ironwork. One frequently sees ceilings thus represented in vignettes of manuscripts of the 15 th century.

Since one wearies of everything, even of things justified neither by reason nor by taste, we can hope to see abandoned some day the heavy ceilings with coves and great coffers, with figures in the round and with draperies mingled with garlands and vases, so much in vogue since the reign of Louis XIV, the return of ceilings whose forms will be indicated by the construction, whether in wood or iron.

It must be stated here that from the 15 th century, between the beams of floors were frequently made deafenings of plaster laid on boards placed on strips nailed at two-thirds the depth of the beams, both to preven the dust from sifting through between the tongues of the covering floor, as well as to avoid transmission of sound through floors entirely of wo wood. These deafenings were painted and even sometimes were decorated by plaster reliefs. One sees some ceilings of this

kind in old houses of Orleans. Above the deafenings was left a space, then boards were laid on the joists and troughs were formed also in plaster, in which was placed the marl or even earth intended to receive the tile floor.

PLATE - BANDE. Platband. Horizontal Arch. Lintel.

This is a lintel jointed in voussoirs. The platband or combination of stones placed horizontally on two jambs, being a vicious principle in jointing, the architects of the middle ages scarcely employed it more than the Greeks. The Greeks d did not accept the arch, and if they had to cover a spance b between two piers, jambs or columns, they placed on these vertical points of support a horizontal monolith. The Romans proceeded the same in most cases, although they had already jointed lintels, and thus had made actual platbands. With rare exceptions mentioned in Artsa construction and Fenetre, the architects of the middle ages always rejected the lintel composed of voussoirs. If the feared a rupture, they turned a relieving arch over it. We are less scrupulous, and we place in our public or private edifices as many platbands as there openings or bays covered horizontally; only we take care to support t that vicious jointing by means of strong iron bars.

Then why not employ monoliths? Let us omit the mention here again of the platbands of our grand monuments, like the colonnade of the Louvre, the Garde-Meuble, Madeleine and the Pantheon, whose voussoirs are strung on iron bars suspended by ties from the upper arches. One understands that the architects of the middle ages could not force themselves to falsify in that fashion the truest of the most natural principles of combination, and that it is for that , that several men regard t them as artless persons.

PLATRE. Plaster. Plaster of Paris.

Gypsum burned in a furnace, ground fine and combining rapidly with water to form a solid, light and tolerably hard body, a very poor conductor of heat.

It is a prejudice to believe that the constructors of middle ages did not use plaster. On the contrary, this material was not only adopted in private structuresl but also in public e edifices. Indeed plaster is an excellent material, the quest-

question being to employ it properly.

Pure plaster being mixed with a proper quantity of water, as soon as it begins to set (which occurs almost immediately after mixing, swells and assumes a volume considerably greater than it had in the liquid state. On the contrary, as the water evaporates and when it dries, it loses in volume. One understands that this shrinkage may be dangerous in some cases and produce settlements. So the constructors of the middle ag ages never employed plaster in the large masonry, in what we now term rough walls, nor (except in very rare cases) to fill beds of joints of stones. They always set their courses of s stones on a bed of mortar, and for their concrete between facings, they only employed mortar with coarse sand. Yet it sometimes occurred, that it was not possible to set voussoirs, for example, on beds of mortar, when the centering had a very great span, and the arches were very deep; then the joints were run in good plaster. Thus were originally turned the voussoirs of the arches of the western rose window of the cathedral of Paris; and it must be stated that the plaster was excellent, for the plates of the joints were removed as thin s slabs 0.04 in. thick without breaking.

It was principally in the interiors that the architects of the middle ages employed plaster, to make deafenings and to cover the floor areas, the panels of half timber work, for partitions, also to form coatings. Most half timber partitions of houses of the 14 th and 15 th centuries are paneled in plaster. We have seen sometimes even windows from one room into another with plaster tracery. In the palace of the archbishop or Narbonne, under the passage from the entrance gate exists a little rose window of the 14 th century in plaster moulded on iron bars, and looking into the adjacent great hall. Also at that epoch were made of moulded and carved plaster the mantles of fireplaces (Art. Cheminee), cornices of apartments, screens,[1] and double openings closed by tapestries. Very early and during the primitive merovingian and Carlovingian epochs, coffins were made of plaster, and in excavations in old cemeteries are found numerous remains. Men also employed sifted plaster to make coatings on stone and even on wood, in order to apply painting to them. The monk Theophilus speaks of numerous works in wood in which plaster plays an important part.

Pure unadulterated plaster acquires great hardness, has a brilliant fracture, is very white and strong. Now the people of t the middle ages, artless as all know, had not discovered all the modern procedures by the aid of which one falsifies that excellent material, and their coatings of plaster have a remarkable beauty. However even good plaster does not resist atmospheric agents, and it cannot, and should not be used, except in interiors or in well sheltered places.

Note 1.p.208. The screen was a temporary or permanent portion (clotet) in the great hall. Many great halls of castles thus had screens, that formed as many cabinets to which one could retire. Those screens were only 6.6 ft. high and without ceilings. They were replaced later by folding screens, borrowed from the divisions that the Chinese make at once in their dwellings.

PLOMBERIE. Leadwork. Plumbing.

Works in wrought or cast lead, intended for covering edifices, to conduct water, to cover carpentry exposed to the air. Leadwork plays an important part in the architecture of the middle ages; it was also an antique tradition, and one cannot excavate a Gallo-Roman edifice without uncovering in the rubbish some remains of lead sheets employed for covering gutters or even roofs. Under the Merovingian kings, entire edifices, churches or palaces, were covered with lead. S. Eloi passes as having caused the covering of the church of S. Paul-des-Champs with sheets of lead artistically wrought. Eginhard [1] writes in one of his letters, that he is occupied in covering the basilica of the martyrs Marullin and Pierre:- "A purchase of lead," says he, "for a sum of 50 livres was agreed on between us." He adds, "that although the works on the edifice are not yet sufficiently advanced for me to occupy myself with the c covering, yet the uncertain duration of this life seems to make it a duty, for us to hasten so as to complete, with the aid of God, what we have been able to undertake for utility. Thus I address myself to your good will in the hope that you will be able to give me information concerning that purchase of lead." Frodoard, in his history of the church of Rheims, [2] relates t that archbishop Hincmar caused the roof of the church of Notre Dame to be covered with lead. Later at the end of the 12 th century the bishop of Paris, Maurice de Sully, left by will

5000 livres to cover with lead the roof of the choir of the existing cathedrel. The industry of the worker in lead thus dates in the first centuries of the middle ages, and is continued undiminished until the epoch of the Renaissance. However that industry presents in execution certain serious difficulties, on which we must discourse to our readers, before making known the various means, that have been employed to so solve them. As everyone knows, lead is a verw heavy metal, we very malleable and soft, lending itself perfectly to hammering; but even because it is malleable and heavy, it is always disposed to load and tear the fastenings, that hold it to the shape of the wood that it is intended to cover. The work of the plumber must then tend to maintain the sheets of lead, that he employs, in a sufficiently complete manner to resist the weakening caused by the weight. From this point of view, the old coverings are very judiciously arranged. Further, heat strongly expands this metal, just as the effect of cold contracts it. If it is not left free, if it is attached in a fixed manner, it swells up in the sun and trears the fastenings during great cold. It is then necessary:- 1, because of its weight, it must be strongly supported to not sink; 2, it must be free to expand or to contract, according to changes in temperature. Other difficulties present themselves in the use of lead in coverings. Formerly was employed only lead cast on a sand in sheets more or less thick. this procedure had the advantage of leaving to the metal all its purity, and of not c concealing defects that appeared, but it had the inconvenience of giving the sheets thicknesses not perfectly uniform, so t that expansion acted unequally, or the weight was not the same everywhere. The rolled lead employed very generally today has a uniform thickness, but rolling conceals cracks or defects, that soon appear under the action of the air, and that occasion leaks. Further, rolled lead is subject to pits, which does not happen to cast lead. These pits are made by insects, t that perforate the lead in places, and thus form holes about .004 in. diameter, through which the rainwater enters. We have never had to mention this sort of perforations in the old cast lead, while they are very common in rolled lead. We leave to the learned the care of discovering the cause of this singular phenomenon. Another is produced in the use of lead to cover

wood. Formerly the timber and battens employed in carpentry h had long remained in water, and were perfectly purged of sap; today these timbers (of Oak) are often badly purged or not at all,[1] and it results that they contain a considerable quantity of pyroligneous acid (particularly the wood of Burgundy), which forms with lead an oxide, white lead, as soon as the metal is in contact with it. The oxidation of the lead is so r rapid in this case, that some weeks after the metal has been laid on the wood, it is reduced to the state of white lead, a and is soon pierced. We have seen coverings laid under these conditions, and it has been necessary to replace them several times within a brief period, until the lead has absorbed all the acid contained in the fibres of the wood. Coats of painting or of pitch interposed between the wood and the metal do not even suffice to prevent this oxidation, so attractive is the lead for the acid contained in the oak. The constructors of the middle ages did not even have to notice that chemical phenomenon, since their wood when used was completely deprived of sap, and their roofings present no trace of white lead when the sheets are raised.

Note 1.p.209. Eginhard. 48 letters to the abbot.

Note 1.p.210. Formerly all timbers, besides remaining in w water, came to the workyard only after having been rafted; to today railway transportation brings timbers that have not been in the water at all, and which contain all their sap. Hence o are very serious inconveniences.

It is with lead roofing as with many other parts of the construction of buildings; we are led a little too much to believe in the perfection of our modern procedures, and care too little to seek the experience acquired by our ancestors. Leadwork is further so intimately connected with the art of carpentry, that if one desires to cover it with boards, it is first necessary to inquire concerning the quality and the source of the wood to be employed. Perhaps because of the traditions from antiquity, men in the middle ages devoted minute care to obtaining and placing wood in the work; consequently they did not experience the disappointments, that we feel today in erecting green timbers, that have never been soaked in running w water. At least one recognizes that this experience, reasoned or not, is good and that it must be taken into account.

Leads employed during the middle ages contained quite a notable quantity of silver and of arsenic; ours are perfectly purified, and have not the quality given them by that natural mixture, and perhaps are thus more subject to pits and to oxidation. We have still seen in place in 1835, before the burning of the roofs of the cathedral of Chartres, the lead forming the covering dating from the 13 th century. This lead was perfectly sound, was cast in sheets with a thickness of about 0.16 in., externally covered in time by a patina, brown and hard, rough and sparkling in the sun. These lead sheets were laid on oak battens, and the sheets were not over 2.0 ft. wide. They had a length of about 3.2 ft., nailed at their heads on the sheathing with nails of tinned iron with very broad heads; the lateral edges of each of these sheets were rolled up with those of the adjacent sheets, so as to form rounds more than 1.6 ins. diameter; their lower ends were held by two iron hooks to prevent the wind from raising them. Here (Fig. 1) is a sketch of this lead work.

Thus the sheets were invariably fixed at the head A; their edges being raised perpendicularly to the place as shown at B, were coiled together and held very firmly laterally by the r rounds C. These rolls were not so close as to prevent the expansion or shrinking of each sheet. The lower ends of the sheets were held by the hooks G, whose tails were nailed on the sheathing. At each lap of the sheets the edge was doubled and formed an enlargement I. At D we give at one-fourth size the section of a roll. According to this principle the roof of t the church of Notre Dame of Chalons-sur-Marne is covered, and in old parts that covering dates from the end of the 13 th century. Here the lead sheets were engraved in lines filled with a black material forming drawings and figures of ornaments; o one sees some traces of this decoration. Painting and gilding eyhance the flat parts between these black lines; for it is n necessary to state that nearly all lead work of the middle a ages was decorated by paintings applied on the metal by means of a very energetic mordant.

The lead gutters of the middle ages are likewise placed for free extension without soldering and without projections. Their external edges are always supported by oak boards, as practised today, but rest on one horizontal round iron rod suppor-

supported at sufficiently short distances by forged branched angles. Here (Fig. 3) at A is the profile of one of those supports, at B being its front seen above the crowning cornice. The angles C are anchored in the cornice slab under the plate R of the roof; the branches are riveted to the rod. The lead sheet of the gutter fixed at a follows the outline a'a" and is rolled up at b, showing externally the angles that support it.

These lead sheets of the gutter are quite thick and with a length exceeding 4.9 ft., being connected by laps as shown in the perspective sketch G. At each lap at the bottom of the g gutter is a drop to prevent the water from passing between t the joints of the sheets or being stopped by the projections of the laps. Further, the gargoyles for discharge are always very near together; for example, each two or three sheets. T The constructors of the middle ages had probably noted that w wood externally enclosed between sheets of lead and without a air, soon heated and was reduced to dust. If they made wooden gutters on houses, they left visible the outer face of the g gutter, only covering it with strong relief, as indicated in Fig. 3, to preserve it from the direct action of the wind. T The fronts of wooden gutters were generally moulded, sometimes even carved and covered by painting.[1]

Note 1.p.213. We have seen remains of gutters of this kind on houses of Rouen, Orleans and of Bourges.

If the plumbers of the middle ages devoted scrupulous attention to the shape of the coverings, they excelled in covering woodwork with lead, in repousse work with the mallet in lead, and they made this industry one of the principal crowning decorations of edifices. Articles Epi and Crete give some examples of these worksin hammered lead, that recall the best models of jewelry of the epoch. It is easy to see, even by the irregularitees of this sort of works, that they were executed without models; they were composed by cutting out ornaments from sheets of lead of good thickness, and giving relief to these falt surfaces by means of small wooden mallets of different forms. Old ornaments, that we have examined with the greatest care, have shown us the traces of that very simple manufacture, but which requires the taste of an artist and of a knowledge of the development of surfaces.

For example, desiring to execute in lead in relief an ornament of the cross-flower or terminal, such as that shown finished a A in Fig. 4, account must be taken of the development of those surfaces on a plane, tracing their outlines on a sheet of lead, cutting them out as shown by Fig. 4 bis, gradually giving the proper relief to that flat surface cut out. These sheets (Fig. 4) are clamped and soldered on a lead stem, indicated in section B made on a b. Bands of lead soldered inside the stem (detail C) slip over the double pins D soldered to the stem and placed at d. Round iron rods e are soldered outside in the grooves formed in the relief of the leaves, and give them stiffness, ending in lead flowers as seen at E. The stem here presents a triangular section, the development of e each of the three leaves remaining within the angle B G H. Th Therefore the three leaves being clamped and soldered together from g to h at the base of their stems, the leaves k are b bent so that they touch at their ends, and they are joined by a drop of solder, which gives stability and stiffness to the upper part. A great acquaintance with the developments of surfaces was required, and of the effects that could be obtained by modeling a flat surface, in order to cut out the leaves w with certainty and without spoiling the lead. But the building artizans never handled developments better than those of the middle ages. Those works that appear so difficult to us, not having acquired in any school the use of these effects, were an attractive sport for them, for they certainly sought new difficulties to conquer.[1] Economizing solderings in this sort of works, they modeled the sheet of metal with charming taste, as one would model clay, and they left to it the appearance suited to that material, without pretending to imitate stone or carved wood. For example, if they had to make a capital, they formed the bell A (Fig. 5), then covered it with crockets, with leaves modeled separately, soldered and clamped to the principal body as seen in the section B. But all t that was light, spirited and detached, as suited to metal. Th The bell was reduced at its middle, and presented a diameter le s than that of the column, so that the applied stems by t their thickness should not exceed the diameter of the shaft. These ornaments were often merely clamped, which avoided all breaks and facilitated repairs. Small iron rods soldered ins-

inside the leaves or crockets gave them stiffness and prevented them from bending.

Note 1.p.215. Without too much vanity, we can state that we were one of the first from 1847, to attempt to revive that industry, entirely abandoned since the 18 th century, for the lead works at Versailles are cast, for example. We have been seconded by an intelligent man, and a very rare thing, one disposed to leave routine guide; M. Durand, since deceased, after having restored to that beautiful industry a part of its splendor.

In all leadwork, it is necessary to foresee the case of repairs, and to arrange the fastenings, clamps, and laps so that it may always be possible to remove easily an injured part and to replace it. The expansion of lead, a defect in a sheet, the blows of the beaks of rooks, who sometimes are intent to pierce a sheet, may require the replacing of a piece of lead. The plumbers of the middle ages foresaw these accidents, for all their lead work is so arranged, that one could remove it in sheets or fragments, just as one removes tiles, crestings or hips of a terra cotta roof, without touching parts in good condition. If the lead directly covers shaped woodwork, like that of a dormer or spire, the sheets are never joined by soldering, but by skilfully placed locks, laps and clamps. For example, a column will be covered as indicated at A, Fig. 6; mouldings will be covered as seen at B, B′. The lead follows the contours and will be stiffened by these frequent bends; it will be fastened at the top alone at b, being covered by upper sheets with clamps, and covering in the same manner the lower sheets. If the ornaments must be fitted to these mouldings, they will be attached on the sheet as seen at B′, i.e., by the clamps and the drops of solder d.

If necessary to place sheets on vertical planes, like the sides of dormers, bases of spires, etc., in order that their weight may not tear out the head nails, these sheets are clamped diagonally on each other as seen at E. Hooks of iron or copper hold the lower edge of the sheet and prevent it from rising. lead clamps are nailed on the wood, are taken to lap and prevent the sheets from waving. Great decorated terminals are composed of a series of cylinders or prisms that cover each other without slodering. Thus these kingposts can be re-

removed and replaced without difficulty. A forked iron bar f fixed on the kingpost of the carpentry will support vertically the different members. In relief lead work forming the ornamentation, soldering is employed only to connect ornaments formed of two parts, like rings, flowers in full relief, or to attach leaves, stems and flowers.

About the end of the 15 th century, hammered lead ornaments were sometimes replaced by lead ornaments cast in moulds of stone or plaster.[1] But those cast ornaments are at a very small scale, and are far from having the decorative appearance of hammered lead. The lead workers made statues of all dimensions, and these are still seen on the roofs of the cathedrals of Amiens and of Rouen, that date from the beginning of the 16 th century. Those figures were nearly always hammered on a model of wood or iron in parts, then soldered together. Then care was taken to make the model very lean and dry, so that the thickness of the lead sheet should restore it to the plumpness lacking to it.

Note 1.p.218. There still exist several of those models; s some are seen in the hospital of Beaune, that served for casting the ornaments of the terminals of the roofs.

What gives the lead work of the middle ages a special charm is, that the means of fabrication employed and the forms adopted are exactly suited to the material. Like carpentry and l like joinery, lead work is a separate art, that borrows neither from stone nor wood the appearance that clothes it. The lead work of the middle ages is treated like colossal goldsmith's work, and we have found striking relations between t these two arts, if not in means of attachment, at least in t the forms adopted. Gold and applied colors replace enamels. Beautiful lead work was also made during the 16 th century, a although the means of attachment and of covering were then l less studied and careful than during the preceding centuries. The spire of the cathedral of Amiens, partly recovered with lead at the beginning of the 16 th century, partly repaired in the 17 th, allows one to appreciate the decadence of that art during the space of a century.

The lead work of the chateau of Versailles and of the dome of the Invalides are recommended rather by the weight, than by the care taken in the execution, while the unfortunately

rare woodwork remaining to us from the 13 th, 14 th and 15 th centuries, is remarkable by its relative lightness and by a v very careful execution. To be convinced, it suffices to see the old lead work of the church Notre Dame of Chalons-sur-Marne, and of the cathedral of Rheims, of that of Amiens, of the mansion of Jacques Coeur, of the hospital of Beaune, of the cathedral of Reuen and that of Evreux,[1] of numerous fragments scattered on several monuments or mansions. There still existed before the end of the last (18 th) century many edifices of the middle ages, that had retained their lead roofing. This lead work has been generally removed. It is then not surprising to find today only a small number of examples. However it is due to studies, so frequently attacked, that we have been able to revive one of the most beautiful of the building industries.

Note 1.p.220. The lead work of the spire of the cathedral of Evreux has been very unskilfully restored at different epochs; one finds in the midst of these repairs only fragments, but e executed wit refinement.

POINCON. Kingpost.

A vertical part in carpentry that receives the upper ends of the principals of a truss, on the hips of a hip roof or spire.

POITRAIL. Sill.

A very large timber placed horizontally on piers or posts and supporting the facade of a house. (Arts. Maison, Boutique, Pan-de-Bois).

PONT. Bridge.

We shall divide this Article into several parts; these are bridges of stone or permanent ones of wood; movabel bridges, drawbridges, and bridges of boats, floating, and those on w wheels (pontoons).

The Romans were great builders of bridges, either of stone or of carpentry, and in Gaul were long used the bridges, that they had built over rivers.

Gregory of Tours relates that king Gontian "sent an embassy to his nephew Childebert, to ask for peace from him, and to

pray him to come to see him. Childebert came to meet him with his great men, and both meeting near the bridge called the s stone bridge, saluted and embraced."[1] This bridge was one bu built by the Romans. Yet they, by reason of the abundance of timber in Gaul, must build a great number of bridges of carpentry, that still remained during the first centuries of the m middle ages, for stone bridges built by the Romans are still to be seen though rare; had they been numerous, traces of them would be found on our rivers.

Note 1.p.221. Book V. Chap. 17. Pont-Pierre, now Pompierre is a village on the Mouzon near the Meuse.

The Romans almost always established arches or monumental gates, either at the ends of bridges or at the middle of their length. These arches became during the centuries of peace, that followed the definite conquest of the soil of Gaul, rather motives of decoration than of defense. but from the first invasions these gates were furnished with battlements, and t they can be regarded as starting points of those little castles or forts, that always were attached to the bridges of the middle ages, whether of stone or wood.

There remain to us no stone bridges of the middle ages preceding the 12 th century;[2] but in that epoch were constructed a very great number and in extremely difficult conditions. One of the most beautiful and most considerable is the bridge S. Benezet at Avignon. The legend claims that a young shepherd, named Petit Benoit, born in 1165 in Viverais, was inspired f from on high, came to Avignon in 1178, and was the promoter and architect of the bridge across the Rhone at the location of the rock of the Doms. Of this bridge still remain four arches and some piers of very remarkable construction. Begun in 1178, it was completed in 1188; its length is 2953 ft.(0.56 mile), and the width of its floor is 16.0 ft. including the b balustrades. To resist the current of the Rhone and masses of ice, the piers are 98.4 ft. from one edge to the other, ending upstream in a very acute edge. It is necessary to state that there the Rhone is very rapid and divides in two branches; one being much wider than the other; the narrower flows beside the rock of Doms, and is of great depth. The difficulties in establishing this bridge were then considerable, the more that at least once a year the fllods of the Rhone reached a height a

averaging 16.4 ft. above low water. Without discussing the mo more or less truth in the legend relating to the shepherd Petit Bernoit, it seems certain that this person was the chief of the confraternity of the "Hospitalieres pontifices"(Hospital bridge-builders), that undertook the construction of the bridge of Avignon. That confraternity was established in the 14 th century to build bridges, establish ferries, and to g give assistance to travelers on the banks of rivers.[1] However that may be, the bridge of S. Benezet was wisely constructed and would still exist, were it not for the wars and the negligence of the people of Avignon.

Note 2.p.221. In his work on Droits ot Usages, M. A Champollion-Figeac cites a gothic bridge of the 11 th century dependant on the castle of the counts of Champagne at Troyes, but that bridge as well as the castle on which it depended were demolished many years since, and the reproduction given in the Voyage archaeologique of M. Arnaud is due to the imagination of that author.

Note 1.p.222. The religious confraternity of Brothers of H-Hospital Bridge-builders originated and was established at M Maupas in the dioceso of Cavaillon after the year 1164, according to the Recherches historiques of Abbe Gregoire. Petit Benoit or S. Benezet was the chief of that institution, and commenced his labors at Maupas; it would be after this first work that he undertook the construction of the bridge at Avignon.

Clement VI caused four arches of it to be rebuilt. The Catalans and the Aragonese cut it in 1395, during the siege of the palace of the Popes. In 1418 the people of Avignon caused the cut arch to be rebuilt; but either the work was badly done, or other parts of the bridge had not been maintained, an arch fell and brought the fall of the others in 1602. In 1633 two others fell, and during the winter of 1670 it is stated that over the main branch two arches fell.[2] These arches were replaced by carpentry, good or bad, but after more than a century this fine monument was reduced to four arches that belonged to the little castle on the city side. This bridge was the sole permanent communication existing between the papal territory of Avignon and the French territory of Languedoc. In t the early time the city had extended its jurisdiction into t the islands of the Rhone and opposite its territory along the

the entire right bank of the river. Its justiciaries had caused the erection of their gibbets, some before the fountain of Montaud, and others on the rock North of the place of the Angles, that is still called the Justice. While the kings of France possessed the city of Avignon jointly with the counts of Provence, they placed no obstacle to this extension of the jurisdiction of the city; but when in the month of September, 1290, Philip the Fair by reason of the marriage of his cousin Charles to Marguerite, daughter of the king of Sicily, count of Provence, he claimed to make respected in future his territorial limits; in consequence his officers in 1307 laid the foundations of the tower of Villeneuve, that closed the bridge at the right bank of the river. Charles II, king of Sicily, complained of this act, that he regarded as an infringement of his rights, consecrated by custom, alleging that the territory of Avignon extended to the shore of the right bank of the Rhone. The king of France directed his seneschal of Beaucaire to make an investigation in the matter of that demand; he traveled to the place and arranged to hear witnesses, when the magistrates of Avignon intervened, saying that the seneschal could not act in the name of the king of France in the place that was of the domain of the jurisdiction of the king of Sicily, count of Provence. Rodolphe of Meruel, architect of the towe of Villeneuve, only pushed with greater energy the construction of that defense, and it did not seem that the king of France, once well placed at that point, would tolerate on the right bank of the river the exercise of the jurisdiction of Avignon. Yet that jurisdiction was exercised for some time in the islands; but after having so well established what they regarded as a right, the officers of the king of France t took care not to stop in such a good cause, and they opposed every act of the jurisdiction in the islands.[1] If we have related at some length this history of the bridge of Avignon a and of the structures that closed it on the side of France, this is to make known that the difficulties presented by nature were not the only ones, that were to be surmounted in feudal times, when it concerned the building of the bridge. Indeed rivers and often small streams formed a boundary between territories belonging to different lords, and the establishment of a bridge destroyed that limit, each one then sought

to close this communication from one territory to another by a little castle, or simply opposed its erection. The feudal divisions, and yet more the weakness of the builders, became an obstacle to the establishment of bridges.

Note 2.p.222. In the collection of Plans et profiles des principales villes et lieux considerables de france, by lord Tassin in 1@@2, there is given a view of Avignon with the bridge of S. Benezet. Two arches are wanting on the island and three over the main branch.

Note 1.p.223. Archives municipales d'Avignon; proces du Rhone. Vol. I. p. 65. We owe this data to the learned archivist of the prefucture of Vaucluse, M. Achard, who possesses on Avignon and the county of Venaissin precious notes, the use of which he has courteously allowed us.

Fortresses on bridges could only be established by authorization of the founders; but it is necessary to believe that necessity often caused this condition to be infringed, for we know no important bridge in the middle ages not so defended. No more could tolls be established without the consent of the founders.[2] William the Great, duke of Aquitaine, by a charter of 993 forbids forever the collection of tolls for the passage of the royal bridge. "Eudes, count of Chartres, Tours and Blois, made a similar prohibition in 1036. He declared that having caused the building of a bridge at Tours with the sole purpose of performing a meritorious action for the good of his soul, he desired that no tolls of any kind should be levied."[3] It probably did not enter the minds of the founders of the bridge of Avignon to establish defenses there, at least on the right bank, and yet we see that a century after its construction, the king of France planted on the bank a fortress, that forbade entrance or exit, and that the Popes fifty years later built a little castle on the left bank. Thus this bridge for public use saw both its ends closed by the two lords, each occupying a bank.

Note 2.p.223. M. A. Champollion-Figeac, in his collection entitled Droits et usages (Paris. 1860), says that "a charter of the emperor Frederic, of the year 1158, and an act relating to the abbey of S. Florent (Coll. de Camps), of the year 1162, for a bridge built over the Loire, again states these two facts" (forbidding the erection of fortresses on bridges or lev-

levying any tolls whatever without the authorization of the founders.

Note 3.p.223. The same, p. 125.

Tolls levied on bridges were ordinarily applied to their m maintenance; but one understands that these resources were frequently diverted from this use; thus most of these bridges were badly maintained. Most of those remaining to us exhibit great deteriorations, that run for several centuries."In time of war the lord of the sword in many provinces of France had the right to demolish the bridges, even those to the construction of which he had not contributed; but it was necessary to be a case of the common safety. Still it was necessary to obtain special permission from the lord of the sword to be able to rebuild this demolished bridge for the purpose of temporary safety."[1] Thus many bridges of the middle ages were cut, and were only repaired temporarily, which also contributed to their ruin. The bridge of S. Benezet found itself precisely in thatccase. What remains of it allows us to study it and describe its construction. The arches had spans of 65.6 to 82.0 ft. and were 18 in number. On the island separating the two branches of the Rhone the causeway was arched, as well as over the two streams. Over the great branch the bridge at the side next Villeneuve formed an obtuse angle, as if to better resist the force of the current. But we shall soon return to that general arrangement. Here (Fig. 1) at A is the elevation of an arch with two piers. It is to be noted, that of the four piers that still exist entire, two are built according to the sketch B and two like C. On one of those like C and nearest the city is built a little chapel dedicated to S. Nicolas,in which were deposited the relics of S. Benezet. The floor of that chapel is placed 14.8 ft. below the floor of the bridge, and one descends there by corbelled stones, partly at the expense of the thickness of the bridge as shown by the plan D.[2] To pass before the chapel there was left to the floor at D a width of 6.6 ft., including the thickness of the balustrade. Through an arch one could see from this pavement the interior of the chapel, and an arch that opened upstream on the pier. The other pier was constructed the same with trumpets, and does not seem to have been intended to receive another little structure;[3] perhaps it only formed a platform very necessary

for a place so narrow and so long. These piers with trumpets probably alternated with those not possessing theg, and which are conformed to the shape B. The arches are not traced according to a circular arc but form an oval, as shown in the Fig. and obtained by means of three centres. This was a means of giving more strength to the branches of the arches, and for permitting the establishment of thumpets with stairs. The piers possessing trampets were pierced by three arches instead of a single one above the projecting ends, the chapel obstructing the central arch in the pier C. That precaution was very necessary to give a passage fro the floods of the river, for the water sometimes rose to the level G.[1]

Note 1.p.224. Droits et usages, M. A. Champollion-Figeac. p. 131.

Note 2.p.224. This plan is made both for the bridge floor and for the chapel below.

Note 3.p.224. There is only mention of one chapel on the bridge of Avignon in all documents, that we have been able to consult.

Note 1.p.226. Notably in 1856.

At H we give the section of an arch with the transverse profile of the pier B. These arches are constructed by means of four rows of voussoirs 2.3 ft. deep,placed end to end. They are actual transverse arches perfectly jointed, whose beds o continue, but are not bonded together. They are made solid only by the mass of masonry surmounting and loading them. It is to be believed that the master bridgebuilder desired in this to copy a Roman bridge quite near, the aqueduct of the Gard, whose main arches are constructed on this system. At K we present a perspective sketch of the trumpets placed at a on two of the four existing piers, with the arrangement of the corbelled stairs, that permits descent to the chapel.

We do not know today how the bridge of Avignon terminated at the city side, when it was built at the end of the 12 th o century. Very high above the level of the streets, it probably ended already at a defense, from which one descended into the city. In the 14 th century the Popes terminated it by a new a and very strong little castle, that defended the entrance to the city; but if one did not wish to enter the city, or if t the gates of the little castle were found closed, one could

descend from the pavement of the bridge to the quay, that extended along the rampart, by a broad flight of steps placed upstream.

On the Languedoc bank, in crossing the bridge, one came against the formidable tower of Villeneuve and its accessory d devenses, he entered the enclosure of the fortress, or indeed by turning to the right and passing through a gate, he entered the outer enclosure of Villeneuve. Fig. 2. presents the general appearance of the bridge of Avignon with the bend formed at the middle of the long arm. At the bottom of the Fig. is the existing little castle built by the Popes. At A is the i island crossed by the bridge and frequently inundated; at the upper end is the tower of Villeneuve. The entire construction of the bridge except the facings of the piers and the arches is made of very small stones very like these facing the tympanums of the upper story of the aqueduct of gard. The masses are entirely solid and laid wit . care in excellent mortar. T The stone came from the quarries of Villeneuve and is not of very good quality. It is to be believed, that if this bridge had been maintained like hhe bridge S. Esprit built soon afterwards, that it would have been preserved till our days, for it was established in excellent conditions, and nearly all i its piers rest on the solid rock; but as seen above, men contributed as much as the terrible waters of the Rhone to destroy it. From the epoch when men must renounce this means of crossing the river, there was established downstream a wooden bridge frequently injured by the floods of the Rhone, and over the small branch for thirty years has been a suspension bridge of very doubtful durability. By glancing at our Fig. 2, one notes that the bridge of Avignon much resembles a foot b bridge of planks laid on boats. The bridge-building brothers, to resist the powerful action of the Rhone at that point, especially during floods, imagined nothing better than to establish in stone and permanently what common sense indicates is to be done, when a bridge of boats is built, aud this was not too badly conceived.

In the country of S. Savourin-du-Port on the Rhone and belonging to the abbey of Cluny, an abbot of that order, Jean of Tensonges, caused to be commenced in 1265 the bridge of S. E Esprit, over which one still passes today. Thirty years were

employed in its construction. The width of its pavement is 1 16.4 ft. and its length is about 3231 ft. (0.825 mile), the number of its arches being 22. These are round and do not present the peculiarity in drawing observed at the bridge of S. Benezet. Yet they are constructed by means of rows of voussoirs set end to end. In the haunches the arches allow the floods of the river to find a passage. The bridge S. Esprit was the last work of the bridge-building brothers. Then the relaxation of that order contributed to its complete decadence. It must be stated that after the 13 th century in civil and religious structures, the schools of the lay masters of works had everywhere repaced the religious corporations, the cities like the lords no longer needing to resort to the bridge-building brothers and others. The bridge S. Esprit forms a bend opposing the current in the great branch of the Rhone, as at the bridge of Avignon. It was also closed at both ends by gates in the 17 th century, and ended at the city side in a quite important defense of the 14 th century, that later formed a part of the citadel, and corresponded to the course of the river downstream. One can obtain an idea of these defenses by glancing at the engraving given in the Topographie de la Gaule.[1]

Note 1.p.228. Edition of Frankfort, engravings by Merion. -- Two arches of the bridge S. Esprit were recently destroyed to be replaced by an arch of cast iron to facilitate the passage of boats. It was necessary to remove with great difficulty t the suppressed pier, whose masonry was excellent.

Among the bridges of the 12 th century that we still possess in France, must be cited the old bridge of Carcassonne, built by the care of the city in 1184. The tolls of this bridge were destined to maintain it. Its arches are round, built with bonded voussoirs, that set separate like those of the bridge of Avignon. Its piers are sharp at both ends and rise to the floor, forming very useful platforms, the pavement having a width not over 16.4 ft. It was formerly defended at the end opposite the city (left bank) by a formidable bridgehead, that enclosed nearly all the present suburb. A chapel of the 15 th century is attached to its first abutment at the downstream side. On the city bank it relied on the defenses of that fortress by a line of flanked curtains. This bridge still serves today, though it has been very badly maintained for a long time.

The old bridge of Beziers dates from nearly the same epoch. The arches are round, that at the middle being higher than t the others, so that the pavement forms two straight slopes. T The haunches of this bridge are opened by arches in foresight of the floods of the Herault, and its piers are flat downstream and sharp at the upstream side. We give (Fig. 3) the central arch of this bridge, with its plan at A and a detail B, indicating the construction of the projections of arches at t the upstream sides. Its pavement is 18.4 ft. wide. The pavements of the bridges of Avignon and of S. Esprit are level, wh which explains the enormous length of those bridges; but the bridges of the middle ages of ordinary length usually present two slopes, the central arch being higher and wider than the side arches, to facilitate navigation and to leave at the middle of rivers a wider and higher passage for floods. Yet it is clear that the architects sought as much as possible to a avoid those slopes, and many of their pavements are nearly l level from the time that their location permitted the establishment of quays and elevated abutments. Yet when they were forced to open the haunches in the foresight of strong floods, they utilized the spaces in the piers to form relieving platforms, and this motive has supplied us with good architectural motives. The exedras of the Pont Neuf at Paris are a tradition of that arrangement, that further dates from antiquity.

"It was provided for the maintenance of bridges," says Baron de Giraudot,[1] "by means of tolls called "pantage" and finally "billette", because of the trunk or branch of a tree to which was attached the tariff stating the tolls to be paid. The toll was required for passage over or for passage beneath. A toll on salt transported by boats supplied the costly maintenance of bridge S. Esprit and of the stones continually renewed, t that protected the piers from the undermining to be feared because of the rapid flow of the river. The tolls on the very old bridge had been established by authority of the lords, b but when the royal power had advanced its work of centralization, the king alone could establish them for his benefit, or that of the tenants of the domain, either in feu or by dues. The lord high justiciars were not maintained in their rights in that respect, except by proving very ancient possession."

Note 1.p.229. See the important article on bridges, publish-

published by that learned archaeologist in Annales archaeologiques. Vol. VIII. p. 17 et seq.

The lord was held for the tolls to maintain the bridges; b but often the pridge was destroyed, and he continued to collect the tolls, if not on the bridge at least for navigation; so t that bridges in ruin, that already became an obstacle for b boating, were still for them an occasion for paying for the right of passage. "At the origin," says Baron de Girardot," the right of tolls carried the obligation to ensure to travellers the safety of their persons and property; in case of theft or murder, the lord was held to indemnify the victim or the party entitled. There are cited decrees rendered in this sense against the lord of Crevecoeur in 1254, the lord of Vicilon in 1269, and others of the same epoch, some being even against the king for thefts committed within his justice(1295). Yet this responsibility occurred only in the day and not in the night." This explains why the bridges of the middle ages are furnished with guards, that collected the tolls, and then maintained the police over their vicinity and in the suburbs. Many of those towers are little castles, that secure the exits from bridges and sometimes their middle, are then actual guardhouses and toll offices. Still most frequently it is necessary to see in those buildings actual defenses, for example, if the bridges give access to market towns or defended cities. T Thus the old bridge of Saintes, now demolished, but which we saw entire 25 years since, formed on the Charente a formidable obstacle, both against the boats coming with hostile intentions, and against parties appearing on the right bank. This bridge was built on the Roman piers, and even presented on one of those near the right bank an antique gate, forming a triumphal arch with two openings.[1] The view (Fig. 4) gives an idea of the general arrangement of this bridge defended by a series of important works. At first at the side of the suburb of Dames, located on the right bank of the Charente, appeared the first gate, then came the Roman arch crenelated on its upper part during the middle ages, then at the city side was a tower of oval plan through which it was necessary to pass;[2] then finally the gate of the city flanked by turrets. From the gate at the suburb of the Dames to the ancient arch the bridge was built of wood, as well as the great tower at the city gate, so

that the floor of those parts of the bridge could easily be removed, all communication being interrupted between the city and the suburb, or between the city and the grea tower. The arches of the bridge rebuilt in the middle ages on the Roman piers were pointed, and the floor was slightly raised at the centre. The grea tower not only defended the bridge, but commanded the gate of the city in case it had fallen into the po power of an enemy landing on the left bank, and dominated the course of the river. The parapet of the bridge was formerly crenelated in order to permit the garrison of the tower to absolutely stop navigation. These defenses did not date before the 14 th century. As for the bridge itself, it dated from s several epochs, as far as the successive repairs made to the arches permitted to be recognized.[3] The bridge of Saintes, a although deprived of its great tower and its defence next the city, did not fail to present a real interest 20 years ago, it was demolished without serious reason and replaced by a suspension bridge, that it is understood must soon be rebuilt, the duration of that sort of bridge scarcely exceeding a half century.

Note 1.p.231. This arch of triumph was taken down piece by piece, when the demolition of the bridge was definitely decided, and it was rebuilt on the bank of the same river by the care of the commission of historical monuments, under the direction of M. Clerget, Architect.

Note 2.p.231. That tower served as the municipal prison at the end of the 16 th century.

Note 3.p.231. The great towers of the gate of the city were demolished after the religious wars, but are perfectly indicated in the cavalier view in the collection of 1574; Civitates orbis terrae. (cities of the earth).

Our old French cities, that mostly presented a short time s particular character, and that one loved to visit when still retaining their monuments, under the influence of a temporary infatuation, permitted the destruction of many precious remains. let us hope that their municipal councils are better instructed in their true interests, and will religiously preserve the remains of their ancient splendor, respected by time, when those remains further can nowise hamper the developments of modern activity, and are an attraction to travelers. The

Roman arch of Saintes, so precious on the bridge, today makes the strangest appearance on the bank, and seems to be an edifice stranded there by chance.

Happily the city of Cahors has not yet destroyed its marvellous bridge of the Calendre, one of the most beautiful and most complete left to us by the 13 th century. The construction of the bridge of the Calendre dates back to the year 1251, and merits a special study. This bridge was connected with the walls of the city, commanded the course of the Lot, and reached the low hills on the opposite bank. The city of Cahors possessed three bridges built on nearly the same model; the bridge of Calendre is that of the three best preserved. It consists of 6 principal pointed arches very high above low water. On the central and the two end piers (Fig. 5) rise three towers; that of the centre being square, and the two end ones are rectangular. From the floor of the bridge crenelated stairs permitted ascent to the second stories of those towers. The city is located at A. On the opposite bank at B rise abruptly quite high hills of limestone. One reaches the bridge laterally by following the course of the Lot, either up or down the stream, as we see at C. It is necessary to pass the gate defended by a little castle D, that commands the road o and the lower slopes of the hill B. This double gate gives a admission at a right angle to the pavement of the bridge before the first tower E. The parapets of this first bay were crenelated, and communicated at one side by a stairs F also crenelated, with the upper defenses of the little castle. It was then necessary to pass the tower E, well defended in its upper part by machicolations, and by a gate with internal machicolations. The gate E being passed, one entered the first half of the bridge commanded by the central tower G, to which one ascended by a stairs constructed within a work built on one of the projections. That central tower was likewise closed by a gate. That being passed, one entered the second half of the pavement, commanded by the third tower H, equipped with machicolations at its top. At the city side the last gate I defended the approaches to that third tower, to which one ascended by a crenelated stairs placed on a flying buttress. The projections of the piers served as relieving platforms and were crenelated so as to flank the bridge and to strike the river.

All these works except the little castle D [1] and the crenelated crests of the parapets of the ends of the piers are still intact, as one sees, and present a very beautifyl entirety. The construction is done with good materials; the voussoirs of the arches have cut extradoses, which is one condition of solidity and elasticity. In this respect, we observe that Roman bridges as well as these of the middle ages always have arches with cut extradoses, and not without reason. Indeed, when heavy loads pass over the arches, if they have a sufficiently great span, there is produced in the haunches a sensible movement of vibration; if the voussoirs are independent of the construction of the haunches, they retain their elasticity and cannot transfer the vibration to a distance; but on the contrary if the voussoirs are unequal or have horizontal parts, i.e., if they are deeper at the haunches than at the keystone, the oscillatory movement is produced in the entire length of the bridge, and it strongly weakens the piers. One can observe this fact on the bridge Louis XV at Paris, built by the celebrated engineer Perronet. When a heavily loaded w wagon passes over the middle arch, one notes a sensible vibration on the entire length of the bridge. To obviate danger f from this vibration, th engineer Perronet was accustomed to insert iron cramps in the tails of the voussoirs; but if he thus ensured the stability of all parts of the bridge, he placed a very active destructive agent in the masonry, one that sooner or later will cause notable disturbances. Arches with out extradoses according to the Roman and mediaeval methods, on the contrary have the advantage of making each independent, and of forming an elastic ring, that can move and vibrate between two piers without transferring that oscillation farther. Our modern engineers are better advised and have returned to that method; but that proves that the constructors of the middle ages had acquired experience in that sort of structures. One can reproach them with having multiplied piers, thereby obstructing the routes of navigation; but it is necessary to consider that the bridges of the middle ages were built to e establish communications from one bank of the river to the other. They were also means of defense, both on the land route and on the river route, and the multiplicity of the piers strongly facilitated that defense. Besides those bridges were

not erected in the space of two or three years, like ours. P Penury of resources caused 10 and 20 years to be spent in building them; therefore it was necessary that the closing of an arch could not overthrow the adjacent piers, and that these should be relatively strong and sufficiently near together to resist the thrusts. The necessity for building these bridges in parts caused the adoption of the pointed arch, this curve thrusting less than the round arch.

Note 1.p.235. There remain only the lower parts of this little castle.

The bridge of the Valendre at Cahors possesses projections of the piers up and down stream, and consequently flanking t the relieving platforms at each side of the floor. Again a reason of defense was the motive of that arrangement, for everywhere that the bridges do not have that importance from t the military point of view, if with sharp projections upstream, the piers are flat downstream, as for example at the bridge of S. Etienne at Limoges, described by M. Felix de Verneilh in t the Annales archaeologiques.[1] That learned archaeologist, to whom we owe such precious works on the French monuments of t the middle ages, has also observed that on several of these bridges of Limousin, those piers are often composed of only a facing of granite, in the midst of which is tamped a mass of earth. That was an economical method, whose use we have been able to prove, and that we think dates from a very high antiquity, for the remains of Roman piers presented the same peculiarity. The projecting ends of several bridges of Limousin give in horizontal section, neither an acute nor a right angle, but a pointed curve, which has the advantage of allowing the sliding of the running water, and of giving greater strength to these spurs; for it is clear (Fig. 6) that the section A presents a greater area than section B, consequently more weight and resistance.

Note 1.p.236. Vol. XX. p. 100.

Let us return to the bridge of Cahors. One will note (Fig. 5), that the external stairs leading to the towers are open on the side toward the city along the parapet, so that if the little castle were taken,by closing the gate of the tower E, the defenders could overpower the assailants and receive reinforcements from the city. But the stairs of the central tower

G is placed in an extension of the span; its entrance being placed under the passage, but masked as understood by the gate that closed that passage. The stairs of the first tower that is in communication with the battlements of the post I, and the post being closed at the side next the city was destined to present a first obstacle to the assailants that could make a descent on that bank. We give (Fig. 7) a birdseye view of the tower E on the bank opposite the city and its dedendances. B Besides the little external castle A, a low defense formed t the bridgehead on that bank and prevented landing near the t tower, presenting a first obstacles on the road B. One will note that in this Fig. the arrangement of the machicolations with little round arches. Each arch is borne by a corble composed of four corbelled courses, that receive a masonry projection at the top, so that each arch forms a separate space with an opening into the upper story. Above the machicolations covered by great slabs are pierced 4 openings very close together, allowing crossbow fire at an angel more or less open. The first and second stories are each pierced by a single slot on each side. The span seen in our Fig. indicates the system adopted by the master of works to erect the structure. These spans are pierced parallel to the floor, at the height of the springings of the arches, by passages below which are seen th three holes intended for placing timbers across and a small floor forming a footway. The centerings of the arches were t themselves set in fixing holes left visible. Thus the service of the masons was done on that footway across the spurs. On t that foot bridge were piled the materials, taken up by movable cranes and set without requiring any other scaffolding. As stated by M. Felix de Verneilh in the note cited above, the bridges of the middle ages were subject to be cut during the continual wars of those times; that was again a reason that compelled the constructors to give great thickness to the piers, for it was necessary that if it was required to cut t the arch, the others should not fail. But also in provision for that case many stone bridges had movable wooden bays. We have recently seen that the bridge of Saintes had two portions of its floor of carpentry; one at the end at the suburb, the other at the city end. Certain stone bridges were furnished with actual drawbridges; such were those of Poissy, Orleans,

Charenton, the Guillotiere at Lyons, Montereau, etc. Also sometimes bridges only consisted of masonry piers with covered or uncovered floors of carpentry.

The examples just given sufficiently prove the importance of bridges during the middle ages as a means of communication and for defense. certain bridges placed at the junction of t two rivers were connected with actual fortresses; for example, such was the bridge of montereau. About the year 1026 a count of Sens had caused the construction on the tongue of land found at the junction of the Yonne and of the Seine of a very strong keep, that served as support to a vast castle, at which adjoined the bridge crossing the two rivers. This bridge was further closed at its two ends by fortified posts. This entirety of defenses still existed in the 17 th century, as proved by the engraving of Merian.[1]

Note 1.p.238. Topog. Galliae.

The bridge of Orleans, on the arrangement of which remain some curious documents, as an example to be consulted from the point of view of the defense. Everyone knows how many feats of arms it witnessed during the siege undertaken in 1428 by the English. Now let us see at the moment of the siege, w what were the works that made this bridge an important defense. Placed on the road connecting the North and South of France a at the nearest distance from Paris, it was essential to fortify it well.

Then at the epoch when the English came to besiege Orleans, they followed the left bank and by Sologne on October 12, 1428, presented themselves before the rampart of Tourelles (Fig. 3 at A). That rampart was then only a work of earth and wood. On the 22 nd they took possession of it, and the inhabitants of Orleans abandoned the fort of Tourellse B to retire to fort S. Antoine F located on the island, after taking the precaution to cut the arch I of this part of the bridge. The English on their side cut the arch K. The men of Orleans hastily established a wooden rampart at the Belle-Croix at G. It was then in that narrow space that took place some of those feats of arms of that memorable siege. The fort of S. Antoine was preceded by a chapel D placed under the name of that saint, and an almonry E intended to receive pilgrims and delayed travelers. At H uas the gate of the city, and at G the little castle.

After the raising of the siege, the work of the Tourelles was repaired, as well as the rampart A. This time the rampart was faced with stone, as shown by the plan on parchment drawn by lord Fleury, surveyor in 1543, and represented in fac-simila by M. Jollois in his Histoire du siege d'Orleans. [1]

Note 1.p.240. Histoire du siege d'Orleans, by M. Jollois, chief engineer of roads and bridges. 1833. Small folio, with letter to the members of the society of Antiquaries of France. 1834.

A second drawbridge was placed before the gate H of the city. A birdseye view (Fig. 9) presents the entrance of the bridge of Orleans, with its rampart on the left bank on the Sologne side, after the repairs made after the siege of 1428. Later in 1591 and 1592 [2] was rebuilt the rampart A with casemates in form of a ravelin with double tenailles, as recent excavations have recognized. But then the gate of Tourelles still existed. The rampart represented in our Fig. 9 was surrounded by a ditch filled by the water of the Loire, and furnished with a drawbridge falling parallel to the river.

Note 2.p.240. Accounts of the city.

A second drawbridge separated (as at the time of the siege) the rampart from the fort of Tourelles. Indeed in desiring to defend this drawbridge defended by the men of Orleans after taking the rampart, there perished the English captain and s some men at arms with him. Joan of Arc set fire to it by means of a boat loaded with combustible materials. The existence of this drawbridge in 1428 cannot then be doubtful. What was called the Belle-Croix located at C on the upstream spur of a pier of the bridge, was a bronze monument consisting of a crucifix erected on a pedestal decorated by a relief representing the Holy Virgin, S. Peter, S. P.ul, S. James, S. Stephen, and the bishops S. Aignan and S. Euverte. Indeed it was a general custom to place a cross on the middle of bridges d during the middle ages. Bifore the rampart of Tourelles was situated the monastery of the Augustines, that the inhabitants of Orleans demolished at the arrival of the English, to c clear the vicinity of the little castle. Yet that monastery was itself surrounded by an enclosure and a ditch, could serve as an advanced work. Thus one only came before the entrance of the bridge of Orleans laterally, as before the entrance of

the bridge of the Galendre at Cahors.

One conceives what difficulties the feudal system must introduce in the construction of bridges. Neither practical science nor boldness, nor even resources were lacking when there was a question of establishing one over a wide stream of water, but rather the good will of the parties frequently interested in making difficult the communications from one country to the other. By the examples already given, one recognizes that if the bridges connected the two banks of a river, it was sought to accumulate as many obstacles to their passage as possible. On the construction of the bridge of Montabana exist complete and extended documents, that sufficiently prove what were the obstacles of every nature opposed to this sort of enterprises. After 1144 the count of Toulouse, Alphonse Jourdain, in giving to the citizens of Montauriol authority to found the city of Montauban on the banks of the Tarn, inserted in the charter of the foundation this clause:- "The inhabitants of the said place shall construct a bridge over the river Tarn, and when the bridge is built, the lord count shall agree with six experts, the best advisers of the inhabitants of the said place, concerning the tolls that shall be established there, so that the said bridge can be maintained and repaired."[1] But the growing city was too poor to put into execution such an enterprise. Then came the wars of the Albigenses, which reduced that province to the most frightful distress. Only in 1264 the consuls of Montauban could take such financial measures proper to ensure the construction of the bridge over the Tarn. In 1291 the city purchased the island of Castillons or Pissotte, to place there some of the piers of the structure. To one of the kings that had done most to establish unity of power in France, was it reserved to definitely commence the undertaking.[2] Philip the Fair, having come to Toulouse to terminate the differences existing between the count of Foix and the counts of Armagnac and of Comminges, charged with the construction of the bridge of Montauban two masters, Etienne of Ferrieres, royal castellan of the city, and Mathieu of Verdun, citizen, by subjecting all strangers passing over to Montauban to a toll, whose product should be exclusively reserved for payment of the cost of construction, and granting to the consuls for the same purpose a subsidy(1304).

Yet the king imposed as a condition the building on the bridge of three good and strong towers, "of which he reserved the pr property of the guard." Two of those towers must be erected at the ends, the third in the middle.[3] But it was only after vicissitudes of all sorts that the enterprise was completed; the means destined for the construction having been diverted by the consuls at different times. The works were only terminated in 1335. This bridge is entirely built of brick; its le length is 821.8 ft. between the two abutments. Its pavement is perfectly horizontal and rises 59._ ft. above the mean water of the Tarn. It consists of 7 pointed arches averaging 72.2 ft. of opening, and of 6 piers with a thickness of 28.1 ft., furnished with piers at both ends, and pierced over these spans by long pointed openings to facilitate the passage of water during floods. The bricks that served for the construction of this bridge are of excellent quality, and are 2.0 ins. thick, 15.7 ins long and 11.0 ins. wide.[1]

Note 1.p.242. Art. 24 of the foundation charter of Montauban, Archives of Montauban, red book, folio back 105.

Note 2.p.242. See the excellent Note on the bridge of Montauban, given by M. Devals, Sr., in Annales arcaheologiques. Vol. XVI. p. 38.

Note 3.p.242. Archives de Montauban; file D, No. 16, book of oaths, folio 102.

Note 1.p.243. We owe these detailsto M. Olivier, architect of the Department.

The strongest tower was situated at the side opposite the city; these end towers were square, and were crowned by platforms with machicolations and battlements. The central tower was built behind the upstream projection, and was triangular, possessed screw stairs descending to a postern pierced at the level of the river on the city side. This stairs further gave access to the upper spur of the same pier at the level of the sills of the openings placed at the sides of the other piers. There was placed a crane supporting an iron cage intended for plunging blasphemers into the Tarn. According to the custom a chapel had been arranged at the level of the pavement,in the central tower, and was placed under the name of S. Catherine.

We shall merely cite here a certain number of stone bridges of the middle ages which merit consideration. These are the

bridges:- of Rouen, rebuilt at several times and demolished during the last century; of Andre, recenlty demolished and dating from the end of the 13 th century, although it was cut and repaired several times during the 14 th and 15 th centuries; of Poitiers, with two very beautiful gates at its ends, and of which good engravings exist; of Nevers, demolished a few years since; of Tours,; of Auxerre, that possesses a b beautiful tower at one end, and that abbe Lebeuf also saw; of Blois and of Tonnerre; of Sens, terminated at the city side by a considerable tower; of Macon, etc. It is certain that the feudal system was the greatest obstacle to the construction of bridges, at least over wide streams of water, but that in such a case the masters of the middle ages knew perfectly how to conduct the affair, when a sovereign will and sufficient resources set thim to construct these works of public utility. The establishment of great bridges was usually due to the direct intervention of the sovereign, and it was indeed one of the material means for making effective the royal authority in the provinces. Thus we see that at Montauban, king Philip the Fair granting subsidies for the construction of t the bridge, inserted the condition that the three towers should remain in the possession of his men.

It is well understood, that among all cities of the realm, Paris possessed several bridges from a very distant epoch. Du Breuil,[1] has left us the history of those bridges, modified, destroyed and rebuilt many times, both in wood and in stone. One cause of the ruin of bridges in Paris was the houses and mills permitted to be established on the piers and arches. t The oldest of those bridges was the bridge Grange and the bridge petit-Pont, the first having a fort next the Rue S. Denis called the Grand Chatelet, the other next the Rue S. Jacques called the Petit Chatelet. Although these two little castles already existed from the time of Philip August, since the counts of Flanders and of Boulogne were held prisoners there af after the battle of Bouvines, yet both these defenses had been rebuilt in great part, if not entirely at the end of the 13 th and the beginning of the 14 th centuries, after the terrible floods of 1280 and 1296, which ruined the two bridges.

Note 1.p.244. Theatre des antiquites de Paris. 1612. p. 233.

As a result of that disaster the Petit-Pont was rebuilt in

stone in 1314 by means of fine laid on the Jews. As for the bridge Change, they were contented to rebuild it in wood. The bridge Notre Dame, whose construction some historians place about the middle of the 14 th century, was rebuilt at the cost of the city in 1413. This reconstruction was probably in wood and threatened ruin in 1440, since on Feb. 14 of that year, the parlement by a decree decided that this bridge should be entirely reestablished. This project was not followed by execution, and in 1498 the bridge Notre Dame fell with all the houses on it. "This bridge of wood," says the chronicler,[2] "had 18 paces in width and was supported on 17 rows of piles, each row having 30 piles, the thickness of each pile was a little over a foot, and they had 42 ft. in height. Those passing over this bridge did not see the river at either side, believed that they walked on the ground, and seemed to be in the middle of a street of merchants, for there was such a g great quantity of all sorts of goods, of merchants and of artizans on this bridge, and further the proportions of the houses were so correct and equal in beauty and excellence of their work, that one could truly say, that this bridge merited having the first place among the rarest works in France."

Note 2.p.244. Gaguin. De gestis francorum. Paris. 1522. 8 vo. folio 303, back. C. Malingre. p. 219 of Annales general de la ville de Paris. 1640. folio.

As a result of the disaster of Oct. 15, 1498, the people of Paris accused its magistrates of negligence and fraud, and th they were placed in prison; after which most were condemned to fines more or less great. It was necessary to think of rebuilding the bridge Notre Dame. The two masters of works of the city hall, Colin of Chesnaye for masonry, and Gautier Hubet for carpentry, were charged with the undertaking, and to them were added Jean of Doyac, Didier of Felin, Colin of Biart, Andre of S. Martin and Jean Joconde. The two last were charged with the control of the cut stone. However contrary to the o opinion of Sauval, Colin of Chesnaye and Jean of Doyac had b been selected to superintend the work. "Sixteen men, taken f from the different quarters of the city, worked under their orders, and as a mark of the sovereign power that they exercised, Colin of Chesnaye and Jean of Doyac carried white rods."[1]

Note 1.p.245. Registres de l'hotel de ville, H. 1778. folio 1778.

(See Recherches historiques sur la chute et la reconstruction du pont Notre Dame a Paris, by M. Le Roux de Lincy. Library of School of Charters. 2 nd series. Vol. II. p. 32).

Too many men were called to participate in the construction of the bridge Notre Dame; from this resulted changes in the direction of the work and different opinions, that delayed t the enterprise. It is necessary to read on this subject the curious Notice published by M. Le Roux de Lincy, that gives at length the opinions requested by the municipal magistrates from various persons regarded as competent; some are in favor of piles, others regard them as useless; naturally the carpenters are in favor of piles, the masons for concrete. Yet this bridge was very good and very beautiful some years since, and it does not seem that it was necessary to rebuild it. [2]

Note 2.p.243. If it be necessary to refer to a note written on the cover of the red book of the Chatelet of Paris, the c cost of the bridge Notre Dame at Paris was raised to 205,380 livres, 4 sous, 4 deniers Tournois. Sauval contests this figure without giving his proofs, and claims that the expense rose to 1,160,684 livres.

At the time of the rebuilding of the bridge Notre Dame,i.e., at the beginning of the 16 th century, there was adopted that custom so much in favor today, of consulting a number of professional persons or of offocious men in questions of public works; thus were accumulated opinions and papers, that certainly have a great interest for us today, but which on the whole were of little benefit to the work, and frequently caused useless expenses. In that the history of the construction of the bridge Notre Dame passably recalls that of many of our modern structures. Evidently less noise was made and less paper spoiled concerning our old bridges of the middle ages, n nearly all begun with the smallest resources and continued w without clamor,and with persistence until their completion. Yet those bridges were solid and sometimes very bold, since some of them, for example like that of S. Esprit, excite our admiration.

The piers of bridges of the middle ages were erected by means of coffer dams and rarely on piles. They sought a solid bed at the bottom of the rivers and built thereon. If piles were driven, this was upstream from the spurs, when the bot-

bottmo was sandy and to prevent undermining. Thus were built the piers of the bridge Guillotiere at Lyons, and were founded those of the Petit-Pont at Paris, of the bridge of Arche, and of the bridge of Rouen. As for the arches, we have seen t that those of bridges S. Benezet and S. Esprit are composed of rows of voussoirs abutted and not bonded. Some arches of bridges of moderate span, notably in Poitou, are constructed by means of transverse arches separated by a space covered by thick slabs below the floor, as indicated in Fig. 10. These transverse arches are then set in recesses in the piers and retain perfect elasticity. The rainwater that always soaks t through the paving easily passes through the joints of those slabs, and does not effloresce at the haunches of the arches, as too frequently occurs when these are solid.[1] This system of arches has also the advantage of being light, of loading the piers less, and of being economical, since it employs one third less materials in voussoirs. The haunches over those t transverse arches are constructed of rubble or of soft stone, and this can be very easily replaced without its being necessary to interrupt passage. The examples of bridges constructed after this system appear to belong to the beginning of the 13 th century, or perhaps even to the end of the 12 th.

Note 1.p.247. One will notice that most of the old bridges present alterations in the intermediate voussoirs, while those at the sides are intact, because they are more easily dried by the air.

To reduce the considerable expense caused by a bridge built with stone arches, the system was sometimes adopted of only building the piers of masonry on which was placed a wooden floor. Thus had been built the bridge crossing the Loire at Nantes (Fig. 11). On the projections of the piers of this bridge rose little houses let to merchants.[2] Between some of the piers had been established mills; for it is to be observed t that nearly all bridges built very near populous cities or comprised within their walls carried houses, shops and mills. Space was scarce in those cities of the middle ages always entirely enclosed by walls and towers, and the bridges naturally being much frequented passages, was why men sought to place themselves on those ways. The bridges of Paris were c covered by houses and formed actual streets crossing the river.

Even the establishment of these houses, to which the street authorities paid too little attention, contributed to the ruin of these bridges. If necessary to maintain the alignment of both sides of the way over the river, the structures were corbelled out, cellars and recesses were made in the piers, and the walls of these bridges must soon fall. When the demolition of the houses on the bridges of Notre Dame and of S. Michel at Paris was completed, it was necessary to repair the external surfaces and the haunches of the arches at the piers, each occupant having gradually excavated these haunches or c changed these surfaces.

Note 2.p.247. This bridge still existed in that state about the middle of the 17 th century; we do not know precisely at what epoch it was erected. (See Topog. de la Gaule, engraving by Merian.

Bridges of wood played an important part in the architecture of the middle ages, their establishment being easy and not expensive. We find again the tradition of Gaulish wooden bridges in Savoy. In that province to cross a torrent, on the steep slopes forming its banks were piled some great blocks of stone like abutments (Fig. 12), and then on these stones were laid trunks of trees, alternately perpendicular and parallel to t the direction of the ravine, corbelled out. The intervals left between these logs were filled with stones, so as to form a heavy and homogeneous pier presenting sufficient resistance. From one pier to another were thrown two, three or four fir timbers or more, according to the width to be given to the floor, and on these logs were nailed cross pieces of wood. T This primitive construction, daily still employed in Savoy, singularly recalls those Gaulish works mentioned by Cesar, a and that were composed of trunks of trees placed at right angles in layers, between which were fillet blocks of stone. T This procedure is merely piling, and cannot be regarded as a work of carpentry, and must date back to the highest antiquity; we mention it here to make known how certain traditions are perpetuated through centuries in spite of the improvements introduced by civilization, and how much they must always fix the attention of the architect.

This sort of works must seem barbarous in the eyes of the Romans, such excellent carpenters, and we still see them built

in our days in the midts of peoples in contact with our civilization. Because that the works of men always retain something of their starting point, and tha in the mature age of the peoples one can still find the trace of the first attempts of their infancy. Thus for example in the more elevated order, we see the carpenters at Rome execute considerable works of carpentry by the aid of very short timbers. That was a method a adopted by the Roman armies . Not being able in a country to procure engines suitable to hoist very large timbers, they a adopted combinations of carpentry that permitted the construction in brief time, of works of great height or of great extent. Those Roman traditions were still preserved among us during the first centuries of the middle ages, when difficulties of transportation and hoisting caused men to employ short timbers to execute carpentry works, particularly in the country. Villard of Honnecourt gives the sketch of a bridge built with timbers 20 ft. long.[1] (Old French text).[2] The means indicated by Villard of Honnecourt is very simple, and recalls the works of carpentry that we see shown in the reliefs of Trajan's column and of the arch of Septimus Severus. Villard erects two abutments of masonry (Fig. 13), to which he first fastens the ends B of the two angles A. The struts of these angles framed into the posts D are stiffened by the ties E. On the top beams of these angles he erects the posts G, H, maintained in all d directions by X-braces. Second caps K connect the heads of t those posts and are relieved by the braces L with ties as those beneath; then on these last caps are placed horizontal t timbers to connect the two corbels and hold them in line. It suffices to nail planks on these beams. By taking for this w work only timbers 20 ft. long, as Villard says, one can easily have a perfectly rigid floor 50 ft. long, That seems to our a author to be a correct structure, that he surmounts by a gate at each end.

Note 1.p.249. Album de Villard de Honnecourt, manuscript p published in fac-simile. Lassus and Darcel. 1858. pl. 38.

Note 2.p.259. "By this means one builds a bridge over a stream with timbers 20 ft. long."

As for wooden bridges placed across great streams, they are composed of rows of piles, usually single and tied together by strong braces at both sides. On these piles are set caps

caps connecting their heads, and then the floor relieved by braces. The piers are composed of single rows of piles, and have the advantage of opposing no obstacle to the current. T Triangular guards attached upstream divert blocks of ice or floating bodies, that might injure the piers.

Like the Roman armies, those of the middle ages did not commit the fault of establishing permanent bridges on rivers for the passage of their men and equipment. In the Chanson des S Saxons, Charlemagne caused the erection of a bridge on the R Rhone:- "Barons," said he to the assembled chiefs:- (Old French poem). [1]

Note 1.p.251. Chanson des Saxons. Chapter 118.

A poet speaks, and we quote his views only as the expression of a general fact, accepted in the armies of the middle ages.

Wooden bridges never having but a quite limited duration, there remains to us no work of that kind preceding the 16 th century, and we can obtain an idea of them only by vignettes of manuscripts, or engravings,of the 16 th and 17 th centuries. If one desires to establish wooden bridges, either it is necessary to bring the piers nearer together, so as to give the spans of the bays of the floor but a small length, thus avoiding their deflection; or it is necessary to support these floors by struts sufficiently inclined to resist flexure, and t then to extend the piers much above the level of the water; or the floors must be suspended by a system of trusses. The last system seems to have been frequently adopted during the middle ages. Let (Fig. 14) there be piers of three rows of piles spaced 39.4 ft. between axes; on the heads of those piers rising at most not over 6.6 ft. above the level of the water, s stringers E are set on the heads of these piers, relieved at A by trusses B. These trusses are slightly inclined toward each other and are made stable by means of the upper cross beams C and Y-braces D. On these stringers E are placed strong beams F and then the planks forming the floor. These works present great rigidity, but cannot exist long without deterioration, and were scarcely built except over streams with inconsiderable floods.

Du Breuil, [1] speaking of the bridge S. Michel at Paris, says that it was of wood and was built in 1384 by Hugues Aubriot, then provost of Paris. This bridge was covered by several ho-

houses. Bridge Notre Dame, built in 1414 according to the same author,[2] by the report of Robert Gaguin "was only of wood, n having a length of 74 paces and 4 ft., in width 14 paces; at both sides and on which were built 60 houses of equal structure and height, and which after existing for only 92 years, fell into the river in the years 1499, on Friday, Oct. 25."

Note 1.p.252. Theatre des antiquities de Paris. p.241.

Note 2.p.252. The same. p. 243.

As we have seen previously, certain stone bridges possessed movable wooden bays, either to intercept communication from one bank to the other, or to allow boats to pass. These parts of the floors in carpentry were raised by means of frames with counterpoises, as still practised today, or indeed rolled on the stringers, the first were called lift bridges and the second rolling bridges.[1] The first were actual drawbridges. It is to be noted that the drawbridge as understood today, a adapted to the gate of a city or castle, was only first employed about the beginning of the 14 th century, hinged bridges until then being arranged with counterpoises.[2]

Note 1.p.253. From the Latin word "positus."

Note 2.p.253. Old French poem. Romans de Garin le Loherain. Vol. II. p. 175. Edit. Techener. 1833.

If about the end of the 13 th century were already established drawbridges, these were isolated and were not attached to the gates themselves, as since practised. They formed a part of the wooden advanced works belonging to the barrier, but w were not arranged in the masonry of the gates. Yet from a remote epoch were frequently employed bridges or foot bridges r rolling on stringers, and which we give in elevation at A, (Fig. 15), composed of two parallel timbers B, under which w were fixed rollers. A floor of planks was nailed on these timbers. Four pulleys C, whose pivots were strongly fixed in the side walls, received two chains fixed to the rings D fastened to the beams. These chains coiled on a windlass F, whose pivots turned in sockets likewise fixed to the side walls. Under the movable timers B were fixed two beams G, on which rolled the little rollers. By turning the windlass from a toward c, the movable floor was moved forward across the ditch F, and came to rest on the pivot H; by turning it from b toward a, t this floor was returned under the passage of the gate. The r

rear end I of the floor served as a counterpoise, and always allowed one to pass over the pit of the windlass when the bridge was drawn forward. A perspective view will better illustrate this very simple mechanism. To make it more intelligible, we have assumed that the side walls M in which are fixed the pullies and the pivots of the windlass, are removed; we have likewise omitted the upper masonry of one of the flanking towers between which advances the footbridge. In the perspective Fig., the floor is assumed to be returned. Many of this sort of bridges were established in the Italian works of the 15 th century, as stated by the very curious work of Francesco di Giorgio Martini,[1] and in our fortifications built at the time of the adoption of artillery.

Note 1.p.255. Trottoto di orch.cio.et mil.di Francesco di Giorgio Martini, Acchitsonese del seculo XV, published for t the first time by Chevalier Cesare Soluzzo. 1841.Turin.

One recognizes the use of different systems of bridges with counterpoises before the gates of the middle ages. Sometimes these bridger are arranged to be lowered, at other times to be raised.

In the provinces of the East and on the banks of the Rhine were frequently adopted balanced bridges presenting the arrangement indicated in Fig. 16. These bridges consisted of two principal beams A, connected by cross beams aud X-braces. The front portion B of the floor was covered by planks. Two slots R were arranged in the masonry as indicated in Fig. 16 bis, and permitted the rear portions of the beams A to drop to the level of the masonry floor C, built under the passage of the gate. Then the floor B being horizontal, and to retain it in that position, under each beam was arranged a beam D sliding on two rolls E. When one desired to fix the floor and prevent it from descending, it sufficed to push the iron lever F, pivoted on a bolt at G whose fork passed between two pieces. T The lever being brought to the vertical line, as our Fig. indicates, the beams D slid into two holes I made at the top of the last pier. The sketch K indicates the arrangement of the fork of the lever in section. If one desired to drop the bridge, by pulling on the rope L the lever F was brought to f. Th Then the beam D left its hole I, and loosing the windlass M the weight of the front part of the movable floor became in-

inclined according to the line N O; the end P of the beams r rose to p, and the passage was cut. To bring the bridge horizontal, men bore on the windlass M, and with the hand on ascending the steps H and pushing the lever, the bridge was fixed. The spaces R (Fig. 16 bis) were sufficiently wide to allow the beams to swing and to facilitate the use of levers. There is still seen at Basle a gate arranged to receive a bridge constructed on this system. A portcullis S (Fig. 16) descended to the floor, either horizontal or inclined.

Other bridges were dropped or raised as shown in Fig. 17. The end A of the front floor fell on the last pier, when it was desired to allow passage, and to fix the bridge in that position, the beam B rolling on a fixed beam c was moved by the lever D. By pulling the lever to d, the floor was freed, and loosing the windlass T, the counterpoise G caused the bridge to rise, bringing the end B to b. A fixed inclined floor E led to the movable floor, when that was lowered by means of the windlass T.

These bridges were adopted at the time of the use of artillery so as to avoid the use of projecting beams and chains.to lift bridges, that the besiegers could destroy with cannon. They fulfilled the same purpose, and showed none of their mechanism externally. The balanced bridge (Fig. 17) consisted of two beams with cross beams and planks, each rear end of the two beams having a chain coiling on a windlass. We shall have occasion in Art. Porte to return to these movable bridges and particularly to drawbridges adapted to masonry.

The use of bridges on boats dates back to the first times of the middle ages; this was an ancient tradition neve effaced. Eginhard in the life of Charles and of Carloman relates that the first of those princes caused to be established a bridge of boats on the Danube for use in the war against the Huns.[1]

Note 1.p.257. Latin text.

At the siege of Gaillard, Philip August caused a bridge to be built over the Seine, composed of piers inclined against the current, on which was placed a floor of carpentry. Three great boats were surmounted by high towers and defended that bridge.[1] In his chronicle, William Guiart speaks of a bridge of boats thrown across the Lis and retained by ropes:- (old French poem).[2]

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Note 1.p.258. William le Breton. La Philippide. Chant VII.

Note 2.p.258. Branche des royaux lignages. Verse 4883, et seq.

At the siege of Tarascon, the duke of Anjou and du Guesclin built a bridge of boats across the Rhone.

Froissart relates how the Flemings had established a bridge of "nefs and clayes" on the Escaut before Audenarde.[3]

Note 3.p.258. Chronique de Froissart. Book II. Chaps.58,170.

Philip de Commines tells how the count of Charolais and his allies threw a bridge of boats and casks over the Seine near Moret.

"He (the count of Charolais) caused to be brought 7 or 8 s small boats on wagons and several casks with the intention of building a bridge over the river Seine, so that these lords should have no passage."[4] Farther on the same author thus d describes the construction of a wide bridge thrown across the Seine near Charenton by the count of Charolais. "It was decided in a council, that there should be built a great bridge on large boats;(old French text).[5] That was a bridge with a movable portion, which the current moved as necessary, at the bank occupied by the enemy.

Note 4.p.258. Mem. de Philip de Commines. Book I. Chap. 8.

Note 5.p.258. The same. Book I. Chap. 10.

When the duke of Burgundy attacked the men of Ghent in 1452, he established a floating bridge over the Escaut before Termonde; he ordered the workmen from all parts to build a bridge on casks with ropes and planks; and to defend the said bridge caused beyond the water the building of a great rampart of timber and earth."[6].

Note 6.p.258. Mem. d'Olivier de la Marche. Book I.Chap.25.

In his Histoire du roy Charles VII, Alain Chartier relates that a party of French and Scotch built on the Loire near F Fleche a bridge of wagons fastened together and covered by planks.[1]

Note 1.p.259. Alain Chartier. Hist de Charles VII. 1421.

These examples suffice to prove that bridges of boats were used during the middle ages,[2] either to serve a fixed post, or to facilitate the passage of armies. This sort of bridges greatly occupied the military engineers during the 16 th century; the works that have been left to us present a number of means more or le s practical, employed to make the establish-

establishment of these bridges easy, and to rapidly throw them across to a hostile bank. They sought then to make the pontoons transportable, and for that purpose they were composed of several tight boxes that fitted into each other.

Note 2.p.259. See some of these bridges of boats and casks reproduced in the treatise De re militare of Robert Volthurius.

PORCHE. Porch.

The earliest Christian churches, before the nave reserved to believers, possessed an open or closed porch, intended to contain catachumens and penitents. This arrangement was borrowed from the antique basilicas, which were generally preceded by an open portico. When there were no longer catachumens in the West, i.e., when baptism was given to infants, it was no longer necessary to prepare new converts before introducing them into the church, but the custom of porches no le s remained as established, and in certain cases these even became very important additions, vast vestibules frequently glazed, able to c contain a great number of men and intended for various purposes. It is necessary to recognize that the custom of construcing porches before churches weakened after the 13 th century; many religious monuments were without them after that epoch, while until the middle of the 12 th century, no cathedral, no monastic or parish church was conceived without at least one porch before the principal entrance.

Porches appear to have been adopted in our oldest churches of the middle ages in the primitive church; beneath the porches or vestibules of the basilicas were interred personages of distinction, emperors [2] and bishops. Thus the custom of censing those places and of chanting litanies there was retained in some dioceses, for it is necessary to observe that before the 12 th century, the ecclestiastical laws forbade the interment of the dead in the interior itself of the church. Beneath the porches were then placed the baptismal fonts and fountains in which the believers could make their ablutions before entering the nave; exorcisms were also practised under the porches. It was forbidden to hold courts there and to assemble there for temporal affairs. There were exposed on certain occasions relics and sacred images. "The porches of churches," says Thiers, "are sacred places:- 1, because of the relics or

images there; 2, because they are the place of burial of believers; 3, because they are intended for sacred purposes; 4, because they form a part of the church; 5, because they are so called by the concils of the ecclesiastical authors." 1

Note 3.p.259. See Eusebius. Book IV. Chap. 60. De vita Const.

Note 1.p.260. Diss. sur les porches des eglises. Chap. VII. p.37. Summary.

William Durand observes "that the porch of the church signifies Christ by whom opens for us the entrance to the celestial Jerusalem; it is also called portico from portal, or from what is open to all (a portu)." 2

Note 2.p.260. Rationale. Book I. Chap. 1. Sect. 20.

Yet the porches of churches did not always retain during t the middle ages that sacred character; we have the proof of it in the complaints of chapters or the religious on the subject of the secular uses that they were made to serve. In the collection of the decrees of the parlement of 1292, we find a complaint of the dean of the chapter of Roye against the castellan, who for a long time had held his courts under the p porch of the church. It was enjoined on the bailiff of Vermandois to forbid the said castellan to hold in future his assemblies in that place, notwithstanding that he had long held them there, since it is fully proved that this porch forms a part of the church and serves as a cemetery. 2

Note 2.p.260. Les Olim. Year 1292. Decree 2.

It was probably to prevent those abuses that the great establishments of Cluny and Citeaux erected before their churches porches absolutely enclosed from the beginning of the 12 th century; besides those porches must serve for ceremonies and customs that required an enclosure, as we shall soon see. A n number of porches of cathedral and parish churches even served for markets, and the ecclesiastical authors too frequently rise against that abuse for it not to have been common. Again today we see temporary booths established in certain places on days of fairs, and that the chapters tolerated there the sale of religious articles.

The primitive porches of the middle ages in the West, i.e., those built from the 8 th to the 11 th centuries, generally present themselves under the form of a portico occupying the entire width of the church and having but little depth. Yet

certain porches of churches dependant on monasteries or even collegiate churches are arranged beneath a tower placed before the nave. Such was the porch of the abbey church of S. Germain-des-Pres at Paris, of which remain but very few traces, and that dates from the Carlovingian epoch; such are also those of the abbey church of S. Savin near Poitiers, of the cathedral of Limoges and of the collegiate church of Poissy, all three belonging to the 9 th and 10 th centuries. Then t these porches formed a protected entrance and were sometimes preceded by a ditch, like that of S. Savin, for example. The porches of the church of Notre Dame du Port at Clermont, of Chamalieres, of S. Etienne of Nevers, of the cathedral of Clermont, are built on a rectangular plan and are enclosed; they should be crowned by two towers. Some Carlovingian churches, like the Basse Oeuvre of Beauvais, were preceded by porches and vaulted, by porticos covered by visible carpentry, into which the nave and its side aisles opened widely. About the end of the 12 th century, most of these primitive arrangements were profoundly modified, and the general tendency was to suppress porches placed before the principal facade in order to reunite them to the naves, which causes one to believe that then the ceremonies for which the porches were reserved fell into disuse. A little later, about the middle of the 13 th c century, on the contrary, men built many porches before the side entrances of churches, and notably of the cathedrals as at Chartres, Bourges, Chalons-sur-Marne, and then about the end of this century and during the 14 th, built them before the principal entrances; but all these porches are then open, and are merely shelters intended for believers at entering or leaving the church. They no longer have the sacred character, that one observes in the primitive porches, and rarely serve as places of burial.

To follow a systematic order, we shall divide this Article into closed church porches, ante-churches or narthexes, open porches under towers, annexed open porches, and porches of c secular structures.

PORCHES FERMEES. Enclosed Porches.

We do not think that there were porches in France earlier than that of the Latin church of S. Fron of Perigueux, whose

traces are still recognized. That porch of rectangular form was 33.3 ft. long by 31.7 ft. deep. It was covered by carpentry in two slopes with a masonry gable in front. A wide round archway formed its entrance. Of its very simple external decoration remain only fragments. This porch preceding the 10 th century is described and engraved in the work by M. Felix de Verneilh on Architecture Byzanine en France.[1] This arrangement of a hall preceded by a front gable is contrary to the form adopted for the porticos of the first Latin basilicas, and indicates a modification already very old in the plan of porches on the soil of France, a modification whose starting point o cannot be known to us for lack of existing monuments; it is no less important to state, since we see that after the 10 th century, most abbey churches are preceded by vast enclosed p porches, presenting an actual ante-church, frequently in two stories and that must respond to new needs.

Note 1.p.261. Paris. 1851.

The order of Cluny took possession of this arrangement and made it the motive for monuments remarkable in every respect. One of the earliest closed porches belonging to that order is that of the church of Tournus; it consists (Fig. 1) in the g ground story of a central nave of three bays with side aisles. That central nave is covered by cross vaults perpendicular to the side walls, and resting on transverse arches A. One enters this narthex by a doorway B, opening on a court preceded by a fortified enclosure. The facade itself of the porch was defended. Two towers rise on the two first bays B. From the narthex one enters the church by the doorway D and the two arches E. Great cylindrical isolated and engaged piers receive the imposts of the vaults. In the first story this vast n narthex forms a church with elevated nave covered by a tunnel vault and side aisles with half tunnel vaults (Fig. 2). Slots open in the lower part of that hall, lighted by windows pierced in the walls of the high nave and in the front gable. The transverse section that we give here is taken looking toward the entrance. At A are shafts of the two towers.[1] The entire structure is built of rubble, roughed or plastered. Next the church an arch is pierced in the gable wall at the level of the floor of the second story, and it allows one to see what occurs in the nave. The same arrangement is found again at

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Vezelay. In the abbey church of the order of Cluny, these upper narthexes, these chapels placed over the great enclosed p porch, were generally placed under the name of the Archangel S. Michel. But what was the purpose of this hall or chapel placed over the narthex? In the ancient pontifical of Chalons-sur-Saone is read:- "(Latin text)." Was this upper chapel intended for the penitents? At Vezelay the second story of the porch only extends to the back and over the side aisles; it was then possible for penitents or pilgrams placed on the ground floor to hear if not to see the divine office said in t the gallery; at Tournus it would have been necessary for the penitents to ascend into the upper narthex to hear the mass. At Cluny the porch or ante-church, which was not less than 114.3 ft. long by 33.6 ft. wide, but whose erection does not date beyond the beginning of the 13 th century, possessed neither a second story nor a gallery, but an altar and a pulpit found places near the entrance doorway of the basilica; from that pulpit as from the gallery of the narthex of Vezelay, were not the numerous pilgrims filling the porch or even penitents, prepared by being permeated by the sanctity of the place, before then were permitted to enter the church? The attendance was such in the 12 th century in the churches of the order of Cluny on certain occasions, that one well understands why the religious did not open at first the doors of the church to the multitude waiting, in order to avoid disorder, that would not fail to arise in the midst of such mobs. Those great narthexes seem to us to be places of preparation; also perhaps they served to shelter the pilgrims, that came from afar and arrived before the opening of the doors, and h had neither the means nor the possibility of obtaining a refuge in the city. On the night preceding certain great festivals at Rome, does not one see people from the country pass t the night under the porticos of S. Peter?

Note 1.p.262. For more ample details, see the engravings m made from the drawings of M. Questel in the Archives des monuments historiques, published under the auspices of his excellency, the minister of State.

The porch of the abbey church of Tournus dates from the 11 th century; it is the oldest among those belonging to the orde of Cluny.

The nave of the existing Cluniac church of Vezelay, probably built by abbot Bartaud and consecrated in 1104, originally possessed only a low porch of small depth, whose traces are s seen at the north side. This nave was restored and even rebuilt in great part by abbot Renaud of Semur about 1120.[1] The p porch must have been built a little after the death of that abbot, either by abbot Alberic or by abbot Ponce, from 1130 to 1140.[2] for after that epoch the monastery of Vezelay until about 1160 had to sustain such ruthless struggles, either against the counts of Nevers or against its own vassals, that it is impossible to admit that during those calamitous times, t the religious could have had leisure to undertake such a vast structure. Besides the archaeological characteristics of the architecture of this porch assign it to the date from 1130 to 1140.

Note 1.p.264.

This abbot was the nephew of S. Hugues, abbot of Cluny; he was made archbishop of Lyons about 1126, and was buried at C Cluny. His tomb was placed near the column nearest the main altar and bore this inscription:- "Here rests Renald II, formerly abbot and rebuilder of Vezelay, and then archbishop."

The construction of the porch of Vezelay is certainly one of the most remarkable works of the middle ages. This porch is enclosed and like that of Tournus, presents an ante-church 82.0 ft. wide by 68.9 ft. long inside. We give its plan (Fig. 3), at A at the level of the ground story and at B at the level of the galleries, for the space C D rises from the ground; the side aisles E alone formed galleries and the area F was a large gallery over the old doorway of the nave. One could ascend to the galleries only by two stairs G, partly of wood a and partly made in the theckness of the front walla Two towers rise on the two first bays H of the side aisles. Above t the level of the galleries about 1240 was rebuilt the great window K (Art. Pignon, Fig. 9), probably to light better the great hall. At the level of the gallery, three openings L open on the nave of the church (Art. Architecture Religieuse. Fig. 21). An altar was formerly placed at O on that gallery. The instructions to pilgrams or penitents gathered on the g ground floor could be given from the top of the balustrade enclosing the gallery at M.[1] Before the construction of the

porch, the three openings next that gallery were windows without glass, like all other windows of the church; that at the middle terminated in a half dome and perhaps received a statue. The principal doorway C of this porch is surmounted by a great relief representing Christ surrounded by the 24 old men a and the elect in the tympanum, the Magdalen perfuming the feet of Jesus, and the resurrection of Lazarus on the lintel. The internal capitals are very richly sculptured with a very remarkable refinement in execution. Formerly the great vaults as well as those of the galleries were entirely painted. We present (Fig. 4) a perspective view of the interior of this porch, taken from the gallery across the facade. One will note that the vault over the gallery has pointed arches. This is perhaps the first example in France of that kind of construction, the other vaults of the narthex being much stilted cross vaults. (Art. Ogive, Figs. 3,4,5). The entirety of this interior is of admirable proportions, and the bays are studied by a consummate master. (Art. Travee). It does not appear that anyone was ever buried under that porch, and the excavations that we have even made there show no trace of burials.

Note 1.p.265. See the transverse and longitudinal sections of this porch in Archives des monuments historiques, published under the auspices of his excellency the minister of State. Also see the reduced transverse section of the porch of Vezelay in Art. Architecture Religieuse, Fig. 22.

The vestibule, narthex or closed porch of the mother abbey church of Clunywas even more vast than that of Vezelay, but it possessed neither tribune nor vaulted upper galleries. It was a great hall with side aisles reached by two flights of steps 42.7 ft. wide. Two towers rose before the five bays contained by the narthex, leaving between them an open porch. T The enclosed porch of Cluny was 114.3 ft. long by 33.6 ft. d deep inside; fluted piers after the fashion of upper Burgundy, Lyonnaise and of upper Marne, supported the vaults of the side aisles. Above rose a triforium also with pilasters, then the high cross vaults with pointed arches and round arched windows in the tympanums. The crowns of the upper vaults were 103.3 ft. above the pavement. It was the twentieth abbot of Cluny, Roland I, who erected in 1220 [1] this magnificent narthex, of which our perspective view (Fig. 5) can only give a faint idea.

All the arches of this structure are pointed, except the windows covered by round arches. At the back is seen to appear t the old facade of the church, with its principal doorway and its blind upper gallery, at the middle of which were pierced the openings, that lighted the chapel of S. Michel, made at the expense of the thickness of the wall and supported by a corbel at the side next the nave. Four figures of apostles in relief decorated the tympanum under the side arch of the great vault of the porch.

Note 1.p.266. See Mobillon. Ann. ord. S. Bened. Vol. V. p.252.

Why was this vast porch erected only in 1220? Must one see here the execution of a new programme, or rather the postponement of a primitive programme? Almost a century earlier, the abbey church of Vezelay built an enclosed narthex of nearly similar dimensions in place of a low and narrow porch. These great enclosed porches were then not foreseen in the first arrangement of the Cluniac churches, and still at Tournus the narthex is of the primitive construction or nearly so. It was only during the second half of the 12 th century that the Cluniacs of Charite-sur-Loire likewise erected an enclosed porch of dimensions at least as vast as those of the mother church of Cluny. There is then reason to believe that this programme was adopted by these religious only during the 12 th century, and that it was designed to provide for the extraordinary multitudes of believers in the churches of that order; which is no reason for surprise, when one thinks that at that epoch, the Cluniac churches were the places most venerated in all Christendom, and as the king Louis VII said in the charter gi given to the monastery of Cluny, the noblest members of his realm. The extent and richness of the enclosed porches of the great Cluniac churches were not surpassed nor even attained in all other cathedral or monastic churches.

The Cistercians also established enclosed porches before t their churches, but these were less extensive and low, affecting simplicity as much as those of Cluny manifested the luxurious tastes of their founders. Besides those porches of Cistercian churches are not absolutely enclosed like those of t the Cluniac churches; they generally present openings to the free air like the arcades of the porticos of the castles, and resemble rather a deep portico than a hall. Thus it seems that

S. Bernard desired to return to the arrangement of the primitive church, and to restore the narthex of the basilicas of Christian antiquity. These Cistercian porches are very low, covered by a shed roof and are never flanked by towers like the porches of the Benedictine churches. (Art. Architecture Religieuse). Pierced by a single doorway opposite that of the nave, they are lighted on the facade by arches neither glazed nor closed, opening above quite an elevated base. Such is also the perfectly preserved porch of the Cistercian church of Pontigny, whose plan we give in Fig. 6. This porch was built in the second half of the 12 th century,[1] and consists of three bays in width and two in depth; it occupies only the width of the great nave. At the two sides A are two enclosed halls intended for the needs of the abbey. Cross vaults without ribs cover this porch and rest on the two columns. An external doorway B corresponds to the principal portal of the nave and at both sides B open on a wide and high base two arches divided by little coupled columns. All this entirety, including the two halls, is covered by a shed roof with half hips at the two ends. Above the roof of the porch is pierced an enormous window in the great gable; it lights the nave. On the exterior, the construction of this porch is of a cold and gloomy a appearance. In the interior the capitals of the columns are decorated by sculptures of entirely Puritan simplicity, and the tympanum of the doorway of the church is only decorated by a cross in relief. Fig. 7 represents the longitudinal section of the porch of the church of Pontigny, and it shows in the full 12 th century, how far the monks of the order of Citeaux were from the splendid programmes adopted by the Cluniacs. In the Department of Aube, the church of the village of Moussey possesses a complete porch established in Cistercian principles. It forms a low shed, not vaulted, at the middle of which opens the doorway; two arches at right and left are placed on a wall and light the shed. These arches are round, doubled, resting on a little pier or column. A fifth similar opening is over the south side. The construction is extremely simple, and appears to date back to the origin of the order of Citeaux.[1] Yet the dryness and coldness of these examples were not long imitated, and from the beginning of the 13 th century, the porches of the churches created under the inspiration of the

monks of Citeaux were already impressed by the most elegant t taste. There still exists at Montier one of these enclosed p porches like a portico, erected on the principles of Cistercian porches. As at Pontigny, the porch of the church of Montier, which dates from the beginning of the 13 th century, opens externally by a central doorway accompanied by four arches, two at right and left, placed on a wall. These were closed by stone tracery in the 15 th century. A pretty porch presenting a similar arrangement still precedes the facade of the church of Tousy. It dates from about 1230. This porch (Fig. 8) is only a narrow portico, quite recalling a cloister portico; it is p pierced by three doorways between which rises an arcade placed on a wall. At A we give the detail of the plan of this arcade. Three pointed archivolts rest on the piers B and the t twin columns C. Small round arches with tympanums form the h heads and rest on the small single columns D. Fig. 9 gives t the half elevation of this porch, as well as its section E ma- made through the tympanum.[2] Many of these porches in the form of porticos and with shed roofs were erected in the 13 th, 14 14 th and 15 th centuries, before the facades of little older parish churches; but generally they are of extreme simplicity, only composed of little piers of stone or posts placed on a wall and supporting a roof with a single slope. These churches were always surrounded by cemeteries, and the porches then served for giving absolution, and the shelter of persons attending the burial. As shown by the last example, they further only formed an enclosure easily entered, the more so that the doors in many cases do not seem to have been furnished with l leaves. One of the largest among this sort of enclosed porches is certainly that preceding the facade of the little monastery church of S. Pere-sous-Vezelay, and which was erected ab about the end of the 13 th century, rebuilt during the 14 th and 15 th. This porch opens on its front by three openings t that do not seem to be arranged to receive grilles or wooden leaves, laterally it was lighted by glazed openings placed on a wall, so as to protect the believers from wind and rain.

Note 1.p.269. The church of Pontigny was in great part erected at the cost of Thibault the Great, count of Champagne, f from 1150 to 1190.

Note 1.p.271. The plan of thew church is given in the work

of M. Arnaud, Voyage archaeologique dans le departement de l' Aube. 1837.

Note 2.p.271. These drawings were furnished to us by M. Sauvageot, one of the most skillful architectural engravers. They were made with minute accuracy.

This structure is covered by six cross vaults resting on engaged piers and two isolated piers. A tomb dating from the earliest epoch of its construction is placed at the left of the central doorway of the church. Other burials were placed beneath its pavement. The figures in relief of the donators are sculptured inside the entrance; these are a noble personage of the locality and of his wife. Unfortunately this structure, which must originally have been very rich and graceful, has been much mutilated, and presents only repaired remains. The porch of S. Pere is a sort of transition from the absolutely enclosed porches of the Cluniacs and the open porches, It rather participates in the church than the exterior; it is also evidently a sacred place. It brings us to speak of porches fr freely open, although still having considerable importance w with regard to the religious edifices that they precede. But before occupying ourselves with open porches, we should not omit here a monument of great interest, although of quite recent date. This refers to the porch of Ry.[1] This church is entirely without style, a rectangular hall of the 15 th century without character. Beside the nave is built at the south side a closed wooden porch, richly carved and in perfect preservation. We give its plan (Fig. 10) and a perspective view (Fig. 11).[2] This pretty porch dates from the first half of the 16 th century; it is entirely constructed of oak and rests on a stone base. The carpentry has a pointed ceiling with visible tiebeams only at the hip as shown by the plan. The entrance opening appears to have never been finished with leaves, nor the openings with grilles. It is then a shelter looking out on the cemetery, and that seems to have been erected by a lord of the place, perhaps to serve for a burial place. Its sculpture is very delicate and of the best of the epoch of the Norman R Renaissance. This little monument, that now counts more than three hundred years of existence, and which is known to be a able to endure more than a century longer, shows how carpentry works established with care and in good conditions can be

preserved in the open air.

Note 1.p.273. By is a village situated 12.5 miles from Rouen.

Note 2.p.273. Again to M. Sauvageot we owe the drawings of this porch.

In examining the vignettes of manuscripts of the 15 th century, it is easy to prove that there existed many of these p porches in carpentry, principally in the northern cities. These porches in wood were always painted and enhanced by gilding. They generally consist only of two side walls supporting the posts and a ceiling with roof. Although sometimes they appear to be suspended over the doorways like canopies, and only supported by corbels.

PORCHES OUVERTS. Open Porches.

Well known are the quarrels, that during the 16 th century, arose between the abbots of Vezelay and the bishops of Autun. The latter then constructed the beautiful cathedral, that we still admire today, and that by its character and its particular style summarizes the religious architecture of upper Burgundy, upper Marne and a part of Lyonnais.

The cathedral of Autun was completed with difficulty about 1140, when was erected the vast porch before its principal f facade. This porch covers a flight of steps extending the width of the nave and side aisles. It is surmounted by two towers with a hall in the second story, formerly covered by visible carpentry. Closed at the sides, the porch of S. Lazare of Autun opens before the central entrance of the church by an enormous tunnel vault enclosing the archivolt of the portal. T This arrangement has a grand effect, the more that the lintels and tympanum of thes doorway are covered by figures sculptured in a strange style, energetic and with remarkable execution. Fig. 12 gives the plan of this porch in the ground story at A, such as it was conceived and very probably executed at first, and at B as it was rebuilt about 1160. Now the lateral enclosing wall corresponding to the wall C is pierced by pointed arches with arcade borne on littel columns, surmounted by windows not glazed. Two towers rise on the two first bays of the side aisles. At the origin (see plan A) the porch must have extended before the side doors D, and the tunnel vault covering it rested on the two thick walls, with two lateral openings E. Today the bays of the side aisles are covered by cross vaults.

Two screw stairs, opening to the nave at both sides of the central portal, ascended to the upper hall. The transverse s section made on a b, c d, (Fig. 13), indicates at A the primitive arrangement of the porch, and at B the present arrangement. One will note the great vaulted niche with half dome r reserved in the gable on the second story and flanked by two doors.

That hall in the second story merits a careful examination, for it indicates a programme peculiar to churches in that part. of France. We have seen that at Vezelay, there was likewise over the great doorway quite a deep niche to receive a seated colossal statue, or even a little altar. At Cluny over the central doorway was a niche opening to the interior, with a corbel in the form of a projecting balcony, in which was a little altar placed under the name of S. Michel archangel. On the interior of the facade of S. Andoche of Saulieu is seen an analogous arrangement, and that church is contemporaneous with the cathedral of Autun. The substructure of the great niche of t the facade of the cathedral of Autun is now engaged in the d depth of the vault of the porch, and the two doorways accompanying it at right and left give exit to two little screw stairs, that have their landings below the floor of the hall. E Evidently these two doors could not open to the exterior but must open on a floor; then from the construction of the nave had been projected a porch more or less deep with a second s story. This hypothesis is more admissible, since there still exists over the niche the rakes of a low roof, that must cover the hall of that projected and unfinished porch, or soon replaced by the existing porch. The primitive porch, according to the arrangement of the rake of the old roof, only covered the great doorway and did not extend before the side aisles. When it was decided to construct the great existing porch, t that comprises the entire width of the facade, it was necessary to raise the rakes of the roof and to obstruct the lower part of the three windows, that light the vault of the nave and are pierced in the great gable. Our transverse section (Fig. 13) then indicates at A the presumed arrangement of the primitive porch, and at B that of the existing porch. After this modification, the great niche in part engaged in the vault and losing a part of its height, no longer seems to have been utilised,

for the upper part of the porch was never finished; but this niche, decorated by pretty fluted pilasters, pierced by a very small opening looking into the nave, accompanied by these two doors communicating with the two screw stairs, certainly had a purpose. Would it contain an altar, like the internal niche of the facade of Cluny, or like the external one of the porch of Vezelay? That appears probably. But for what ceremonies w were reserved those altars placed in the second story over p porches or on an internal tribune? It is what no text informs us till this day.

In our section the dotted line C indicates the level of the external ground before the porch; one takes into account the grand effect produced by this vast covered flight of steps, terminated by this portal so broadly composed. The existing porch is evidently an imitative work, perhaps inspired by the porch of Vezelay, but which alters the primitive character of the monument, recalling those charming Greco-Roman structures of the 5 th century discovered by count Melchoir de Vogue between Antioch and Aleppo. It is not doubtful that the masters of the 12 th century from certain provinces of France saw those monuments, and imitated them in not only the mouldings a and ornamentation, but also in certain general arrangements. Some of these Greco-Roman churches further possess porches with a gallery above the lateral towers.

We believe that we should give (Fig. 14) the plan of the up upper hall of the porch of Autun with its two stairs and doors. The blind arcade borne on pilasters in the interior behind the niche, and that ranges with the triforium of the nave, is pierced by two openings A beside the stairs. For what are these openings? As for the doors B, they open beneath the r roofs od the side aisles of the nave. These oddities prove that we are ignorant of under what religious requirements were erected the porches of the 12 th centurw, which were more or less subject to the influence of the order of Cluny; there is a subject for studies, that we recommend to our archaeologists, and that appears to us worthy to fix their attention. Evidently at that epoch, the porches had a considerable importance, and such important appendages would not have been constructed before a great number of monestic, cathedral or parish churches, unless they must respond to a serious need. We will state fur-

further, that these porches with rare exceptions arose within a quite limited space of time, from 1130 to 1200.

At F is traced the plan of the upper hall of the primitive porch of Autun, and at G is the plan of the vault after the reconstruction of the existing porch; a construction never completed, as we have stated. The cathedral of Autun is not the only one, that was preceded by important porches with a second story. It was only in the 13 th century during the r rebuilding of these great monuments of our cities, that were entirely renounced these dependances. The cathedral of Puy-en-Velay possesses an open porch of the 12 th century with a great flight of steps, or rather the church itself was only an immense porch, whose steps reached the foot of the altar. The front part of the cathedral of Chartres still shows the plan and arrangement of a deep porch with upper hall, that was suppressed only in the 13 th century.

The abbey church of S. Denis possessed a vast narthex very open toward the nave and closed at the external side, but surmounted by a vaulted hall. The little church of S. Leu d'Esserent still retains its enclosed porch of the 12 th century with upper hall; now those structures date from 1140. But h here (Fig. 15) is a porch earlier than the existing porch of the cathedral of Autun, and that presents an even freer arrangement, no less monumental. It is the porch of the church of Chatel-Montagne. The construction of this porch is very little later than that of the church; it dates from about 1130,[1] and retains an entirely Romanesque appearance. Placed on the top of a precipice, the porch of hre mhurch of Chatel-Montagne is preceded by a flight of steps 16.4 ft. wide, with a yard; it presents opposite the nave a great arch and before the s side aisles two narrow arches opened at the side to give greater strength at a to the masonry that receives the weight of the gable. At the sides are opened two other wide arches leaving entire the buttresses that abut the structure of the nave. A stairs b taken out of the southern side aisle of the nave permits one to ascend to a hall over the porch, and that opens to the interior like a gallery. Fig. 16 presents the external elevation of this porch, that with its upper construction forms the facade of the edifice. The character of this architecture is entirely impressed by a good style, whose elements we find

again in the Greco-Roman architecture of the suburbs of Antioch. But here the materials (granite) are small, while those that served to erect the Byzantine monuments of Syria are large and widely jointed. The open windows in the upper arches of this facade light the gallery; the middle arch forms the outline of the internal tunnel vault. We give (Fig. 17) the longitudinal section of this porch with the beginning of the nave, and (Fig. 18) its lateral facade.[1] If the construction is simple and well arranged, one will note that the proportions are most happily established. One recognizes in that pretty edifice the trace of a very advanced and delicate art, carefully studied, and yet the church of Chatel-Montagne is located in one of the wildest provinces of France. Today in those mountains can scarcely be collected some workmen able to execute the most common construction. But the provinces of t the Centre in the 12 th century were a centre of art, active and developed, possessing a school of architects that has left us charming compositions, constructions well understood, solid and in an excellent style.

Note 1.p.279. The Romanesque style was retained in that part of France much later than in the provinces of the North and East. After the end of the 11 th century quickly attaining very great perfection, it was not mixed with Gothic influences about the middle of the 12 th century, like the Romanesque of Burgundy, of upper Marne, Champagne and Berry. During the second half of the 12 th century, the monuments of Auvergne are fifty years late.

Note 1.p.280. The drawings of this porch were furnished to us by M. Millet, charged with the restoration of the church of Chatel-Montagne.

These architects were then certainly religious, and their school followed the decadence from which could not escape the old monastic orders at the end of the 12 th century.

The hall of the second story of the porch of Chatel-Montagne forms a gallery, from one can see what passes in the nave, while in the examples previously given, these upper halls are almost entirely closed next the nave. For what purpose was t this gallery intended? We think that like all closed halls it formed a special chapel, and that an altar was placed against the balustrade, for we also see on the gallery of the church of Montreal in Burgundy an altar of the end of the 12 th century

so arranged. (Art. Tribune). But (in the 12 th century) the organs were not instruments of such great dimensions as to occupy these spaces; the chanters were in the choir or on the rood loft, but not on galleries erected near the entrance. Some authors have claimed that these galleries were reserved for women; but the women being in considerable number at the church would not have found there sufficient space; beside t the texts agree in stating that they occupied one side of the nave from the first times of the middle ages. Tradition in s some localities assigns these galleries to penitents, and we believe that tradition approaches the truth. We admit that an altar was usually placed in the halls open towards the nave, to the exterior to entirely closed; that these altars were o orientated like that of the gallery of Montreale, and that it was reserved for special ceremonies, attended by penitents or believers receiving preparatory instruction. But we must confess that these are hypotheses, and that we have no positive proofs that can be furnished to support them.

Not far from Autun is the monastery church of the 12 th century, Paray-le-Monial, possessing a porch that appears earlier than the construction of the existing church. The plan of this porch (Fig. 19) is regular; it presents on its front three open arches with two arches at each side. Two piers each consist of four columns supporting the six cross vaults, that cover t this ground story. Two towers as at Autun surmount the two f first bays B, and quite imprudently rest on these two groups of columns.[1] One sees that this porch is not placed on the a axis of the nave A, rebuilt on a different plan. In the second story it is surmounted by a hall covered by tunnel vaults resting on archivolts, as shown by the section (Fig. 20). This hall does not form a gallery on the nave, it is closed and o opens at that side only by a window G, whose sill is placed at 6.6 ft. above the floor.

The porches established on this plan then have been adopted quite frequently in that part of France, i.e., in the vicinity of the abbey of Cluny; we see that these plans persist during the 13 th century. The beautiful porch of the church of Notre Dame of Dijon was erected about 1230 on these principles, i.e., with three open arches on the facade, two detached internal piers bearing 6 cross vaults, an upper hall and two unfinished

towers.

Note 1.p.283. M. Millet, charged with the restoration of t the charming edefice, had to replace the columns, that were crushed; he placed in the middle of their group a column of granite, and thus he could preserve all its elegance to this northex. (See Archives des monuments historiques, published under the auspices of his excellency the minister of State.

The arrangement of this porch is remarkable. Built of good materials but wit economy, it is perhaps the frankest expression of Burgundian architecture of the first half of the 13 th century, so original and so boldly combined. The architects of this school only failed to be able to employ materials of absolute rigidity, like granite or even cast iron. Such was the boldness of those artists, that they dared with limestones, of great resistance it is true, but liable to crushing, to erect masonry of considerable weight on very slender piers; supplementing the insufficiency of the material by the wise combination of pressures and resistances.

The architect of the porch of Notre Dame of Dijon proposed a new problem. Having observed by the preceding examples the bad effect produced by buttresses separating the three arches of the facades of the porches, he suppressed these buttresses, and replaced them by a system of stone shores. The idea was ingenious, bold and without precedents. In that way no obstacle separated the three arches, the thrust of the intermediate transverse arches was abutted by the shores, and the weight of the internal angles of the two towers rested on twin piers as on a prop. Some defects in the execution caused these piers to bend toward the two side arches; and since this movement was produced during the construction, or resources failed, the two towers were not finished. They now rise only to the height of the nave. However that may be, and leaving aside the imperfections in detail that produced these movements, in theiry the idea was novel and fertile in results. Thus this porch is one of the most beautiful erected at that epoch, and much superior in conception to the Romanesque porches given in the preceding examples. So this architecture of the 13 th century often shows itself at its origin full of resources, abounding in ideas, but sometimes imperfect in execution. Thus it is not by thoughtless imitation that one must work in our days, but by careful

research in ideas, that have produced its so rapid development, and in its theories fruitful in deductions. From the porch of Notre Dame of Dijon it would be easy, with some modifications of details and by employing materials more rigid than those used in the work, to built an edifice as graceful in appearance and as light, but irreproachable in regard to construction. For that it would suffice to lower the imposts of the lateral archivolts, and to erect the piers with high blocks of very resistant stone. To attain a result with imperfect means, but to allow to be divined the novel idea, the invention, is already much for those that observe and are willing to profit by their observation; for it is easier to perfect means of execution in architecture, than to discover a novel principle furnishing extensive results.

The upper hall of the porch of Notre Dame of Dijon forms a gallery to the nave.

The plan of this porch, half of which is given by Fig. 21, shows how the architect knew how to avoid the external buttresses at A. The two piers D form a double support that receives the front wall of the tower placed on the bay B opposite the buttress C, that abuts the vaults of the porch. At G are opened great windows with sills very high above the ground. In the height of the second story a gallery (Art. Galerie, Fig. 6) extends before the wall of the tower from E to F, and abuts against little turrets H corbelled out on the abutments C and containing the stairs, that permit ascending to the upper stories of those towers. The arrangement of the vaults of this porch is very wisely combined. We have indicated the system in Art. Construction. (See Figs 52 and 53). On the extrados of the archivolts L and J borne by isolated piers forming double supports, are turned the tunnel vaults M and N, that rise from a lintel-impost K. One will note that the architect h has placed the wall of the tower, not vertically over these tunnel vaults but a little behind, as indicated by placing the buttress C, so as to make the piers A and P actual shores. I Indeed, these piers have not left their vertical position on the face of the facade; the piers A and P are slightly inclined toward the lateral bays because of the thrust of the great arches L, D, and because the springings of the arches J were not placed sufficiently low. As for the piers K, although loaded

by the angles of the towers, they have remained vertical, due to the ingenious arrangement of the arches of the vaults.

The external and internal effect of this porch is most happy; the mouldings and sculptures are in the best style.

It is also necessary to cite among the great open porches, built in Burgundy during the 13 th century, that of the church Notre Dame of Beaune. That porch is opened by three arches in front and by two others at each side. As at Notre Dame of Dijon, two isolated columns support the 6 vaults. The porch of Notre Dame of Beaune has never beeu finished in its upper p part, and was not surmounted by towers. On the western facade of Notre Dame of Semur-en-Auxois is placed a porch opening in three arches, but only possessing three cross vaults, and consequently being without isolated columns. This forch is closed at the sides and dates from the beginnidg of the 14 th century, and was completed only in the 15 th century.

The porch of the S. Chapelle of the palace at Paris must be classed among the great open porches. Like the building to which it is attached, this porch is in two stories, and forms a sort of vast loggia open on one court of the palace.[1]

Note 1.p.287. Arts Chapelle, Figs. 1, 2; Palais, Figs . 2,3.

PORCHES OUVERT SOUS CLOCHERS. Open Porches under Towers.

It would be very natwral, when one undertook to erect a tower on the principal facade of a church, to place a porch in t the ground story. In the provinces of the West, Centre and S South, from the 11 th century, men had the habit of building great squar towers before the western entrances of churches; the lower portion of these towers served as a porch.[2] In Art. Clocher (Figs. 41 and 42), we gave the great porch erected on the western facade of the abbey church of S. Benoît-sur-Loire. This porch dates from the 11 th century and is composed of a quincunx of thick piers supporting Roman cross vaults.[3] It occupies a considerable area and is surmounted by a great hall, like the ground story, open on three of these sides and also presenting a quincunx of piers. The tower must rise on the fo four central piers. In the same Article (Fig. 7) is also seen the plan of the porch of the cathedral of Limoges, which dates from the 11 th century, originally open at the sides and supporting a tower. The lower part of the tower of the church of Lesterps presents a porch, whose arrangement recalls the porch

of S. Benoit-sur-Loire (Art. Clocher, Figs. 43, 44), but which dates from the 12 th century.

Note 2.p.287. In Art. Clocher see the map of the different schools of towers (Fig. 81), in which it is proved that two prototypes of these towers at Perigueux and at Brantome, send branches even to Cahors, Toulouse, Puy, Loches, S. Benoit-sur-Loire, etc.

Note 3.p.287. See the entirety and details of this porch in Architecture du 5e au 16e siecle, by Gailhaboud.

These programmes are not found in Ile-de-France, Normandy, Burgundy and Champagne. The porches under the towers of Ile-de-France are generally closed at the sides, like the western porch of the abbey church of S. Germain-des-Pres, and like that of the church of Creteil near Paris.[4] The porch of Creteil was perfectly preserved a short time since; its appearance was monumental. It opened in an arch in front and had a tunnel vault. It is only a shelter before the entrance of the church; long and narrow, closed at the sides, it takes the place of one of those lobbies erected in our times behink the doors. Its construction dates back to the second half of the 11 th century. We give its plan (Fig. 22) and the longitudinal section.(F.23).

Note 4.p.287. This edifice was much changed a few years since.

The single arches of these porches opening externally were closed by hangings, if we can believe old paintings and reliefs preceding the 13 th century; one still sees little projecting corbels or the holes, that served for placing the wooden rod from which was suspended this sort of cloth portieres.

Beneath the tower of church S. Savin near Poitiers exists a porch of the same epoch, entirely covered internally by remarkable paintings. This porch is simpler in architecture than that of Creteil, further presents an analogous arrangement.[1] The western tower of the collegiate church of Poissy rises o over a porch of an early date (Beginning of 11 th century); it likewise opens on the public way by a single arch and has a round tunnel vault.[2]

Note 1.p.289. See Monog. de l'eglise de S. Savin, pub. by the care of the minister of public instruction.

Note 2.p.289. It is also necessary to cite here one of those porches preserved under the western tower of the church S. Severin of Bordeaux, and that dates from the beginning of the 12 th century.

If one penetrates into the provinces of the Centre to Tulle and Cnatre, he sees porches under towers with three open arches, one on the front and two at the sides. These porches date from the end of the 12 th century and participate in the arrangements adopted for porches under the towers of Limousin a and Perigord.

Among the most remarkable porches erected under the influence of these two schools, but however do not posses the internal piers, that we see in the porches of Limoges, Lesterps a and S. Benoit-sur-Loire, it is necessary to cite that of the abbey church of Moissac.

The consthuction of this porch is of great interest for the history of the art. It dates from two epochs, both very near each other, of the beginning and the middle of the 12 th century.

Fig. 24 gives the plan of its ground story. Primitively the porch opened at the south side at C by a wide pointed arch. At the west side at D and on the north side at E, it opened o on the dependances of the abbey, on the cloisters and was closed by doors.

A third doorway F with a central mullion gave access to the nave of the church. Shortly after its construction, i.e., about 1150, was added to the great porch supporting the great t tower a second porch or external shelter G richly decorated by reliefs and by sculptures in a very grand style (Art. Statuaire). The piers H and the buttresses I were erected. These attached structures served to support a crenelated gallery t that defended the entrance of the church. Fig. 25 gives the plan of the hall built over the porch, and on the piers of which should rise a tower never finished. The different tints of the plan indicate the first construction and the additions made at the middle of the 12 th century to receive the battlements in two stories on the external porch at K, and a single defensive gallery at the sides L and M. It was a very bold experiment at the beginning of the 12 th century to cover a hall 32.8 ft. wide by a single vault not a dome, and the architect of the porch of Moissac solved this problem as a skilful constructor. The vault of the ground story is a cross vault, i. e., is composed of side arches wit two wide diagonal arches of rectangular section, on which rest the four triangles of

the vault built of roughed rubble. The vault of the upper hall is composed of 12 arches radiating from a central eye reserved for the passage of the bells. Our section (Fig. 26), made on the line A B of the plan of the ground story, explains this structure. The detail N indicates the jointing of the stones forming the crown of the vault of the ground story (for the d diagonal arches are built of stones of small dimensions). As for the arches of the vault of the second story, that may already pass well for a vault in Gothic style, the diagonals a are round and the 8 others springing from the intermediate piers are circular arcs. One will note that these 8 intermediate arches are set obliquely on the capitals of the piers, w while the abacuses of those capitals have their faces parallel to the sides of the square. Yet already the abacuses of the d diagonal arches are set according to the direction of those arches. (See plan, Fig. 25). These two low and high halls have a monumental effect that produces a strong impression. Although the construction is rude, it is well executed and has not moved. The additions made at the middle of the 12 th century, however interesting they may be, have altered the grand appearance of the exterior of this porch, and have darkened this beautiful upper hall, whose purpose we do not know, and that opens so widely to the exterior. The nave of the church having been rebuilt at the beginning of the 15 th century on a plan analogous to that of the cathedral of Alby, it is difficult today to know how this upper hall was arranged with the primitive nave. Yet the three arches P were bricked up at the rebuilding in the 15 th century, and necessarily opened on the old nave, placing the high hall in direct communication with that without the interposition of glass. But we have already seen by some examples of porches surmounted by halls, given in this Article, that the naves were rarely closed by glass, particularly in the provinces of the Centre and the South, b before the end of the 12 th century.

The porches beneath towers are rare from the beginning of the 13 th century in French architecture. Yet we will cite that of the church of Larchant.[1] Normandy presents some dating from the 14 th and 15 th centuries; we shall mention as one of the most remarkable that of the tower of the church S. Pierre at Caen.[2]

Note 1.p.293. See Monuments de Seine-et-Marne, by MM. Aufauvre and Fichot.

Note 2.p.293. See Pugin, Specimens of the architectural art of Normandy.

On the banks of the Rhine and in the adjacent provinces, t that arrangement continues quite late. The porch of the cathedral of Fribourg opened beneath the western tower is very beautiful. Internally it is ornamented by good figures representing the liberal arts of natural size, Christ, the wise virgins, the foolish virgins, the sacrifice by Abraham, S. John Baptist, S. Mary the Egyptian, etc. This porch opens only by an arch in front, the sides being closed and decorated by the statue, of which we have just mentioned the principal ones.

Speaking of porches beneath towers, one cannot pass in silence the porches so well arranged under the projected towers of the facade of S. Ouen at Rouen.

Those towers must be of colossal dimensions, but were only built to about a height of 65.6 ft. above the ground. When t there was a question of completing the facade of the church of S. Ouen in 1840, they dared not continue the work begun on such considerable dimensions; thus the shafts of the towers were demolished, and so was lost one of the most original and most ingenious arrangements among all those conceived by the middle ages in its decline, for those towers dated from the 15 th century.

They rose on two porches set diagonally and formed skew entrances to the two side aisles. The plan of these two porches is engraved in the work of Pugin on the monuments of Normandy, to which we refer our readers.[2] The oblique position of the church of S. Ouen permitted opening them externally by two s sheltered openings directed to the centre of a large yard formed by the projection of the towers. Thus were avoided air currents in the church, the outer doors of the porch and those opening into the side aisles not being placed opposite each other. The multitude of believers, leaving b: the two side doors and the central portal, naturally found itself gathered on the area of the yard without any resulting inconvenience. There is reason for surprise, tha this arrangement so well designed, and with such happy effect, was not followed in the construction of some of our modery churches, the more that it

can accommodate itself to all architectural styles.

Note 3.p.293. Art. Architecture Religieuse, Fig. 82.

PORCHES D'EGLISES ANNEXES. Porches attached to Churches. Dating from the end of the 12 th century porches attached t to the principal or lateral facades of churches became very common. Why? Before that epoch the most important churches were those dependant on monastic establishments. As we have seen, these churches possessed very vast porches if they belonged to the order of Cluny, in the form of porticos if they were of the order of Citeaux, more or less extensive if they depended on neither of those orders, but formed a part of the primitive or completed plan of the regilious edifices. When these porches were annexed, so to speak, they completed an e entirety of structures conceived after one dominant idea. The parish churches before 1150 were small, poor, and copied more or less the great monastic churches. Before that epoch the c cathedrals themselves were small, and they likewise arose under the predominant influence of edifices due to the religious orders. But when about 1160 the bishops knew how to collect those immense resources, that allowed them to erect churches rivaling those of the religious orders, and even surpassing them in richness and extent, they adopted plans differing in many points from those adopted by the monks. No more chapels, porches or narthex. The cathedrals generally took as a type a basilican plan with central nave and side aisles; doorways w widely opened appeared on the facade, without a vestibule. It seemed that the monument of the city, the cathedral, was especially desired to be accessible to the multitude, that all was avoided that might form an obstacle to its admission. It was a covered forum, to which all were invited without preparation or initiations. But soon, as explained elsewhere,[1] the hope that the bishops had conceived of becoming the political and religious chiefs of the city vanished before the new attitude assumed by the royal power. The cathedrals must restrict themselves to their purely religious functions; chapels were built and enclosures around the choirs; their long naves were cut to install transepts in them; and finally porches were a added before the entrances. Yet as if the primary idea that caused their erection must leave a perpetual trace, those porches were chiefly placed before the secondary or side entrances; a

and the principal facades, the portals, as in the primitive conceptions of these monuments, opened their wide doorways on a yard without porches or external vestibules. We even see t that certain cathedrals, whose plan in the 12 th century had been conceived with a front porch, for example like Chartres, suppressed this porch at the beginning of the 13 th century, to open the doorways directly on the public place. If some cathedrals, which is further rare, possessed porches before their principal facade, for example like that of Noyon; those porches date from the end of the 13 th century or even the beginning of the 14 th; for we cannot regard as porches the wide splays preceding the western doorways of the cathedrals of Amiens and even of Laon.[1] Those are portals, i.e., sheltered doorways.

Note 1.p.294. See Arts cathedrale. Vol. II. p. 280 et seq. Also see Entretiens sur l'architecture. Vol. I.p.263 et seq.

Note 1.p.295. It is necessary to note here (Art. Cathedrale, Fig. 19), that the portal of the cathedral of Amiens was not erected according to its original design. But even on admitting that primitive plan, no more than at the cathedral of Laon, we cannot see in those pronounced splays of the doorways what forms a porch, i.e., an open or closed vestibule.

About the middle of the 13 th century on the contrary, we s see arise well characterized porches before the secondary doorways of cathedrals. At that epoch about 1245 were built the lateral porches of the cathedral of Chartres, Bourges, Chalons-sur-Marne, Mans and Bayeux, and that these porches were ofte n built before doorways not intended to be sheltered. This example was soon followed in the monastic churches. During the 14 th and 15 th centuries were erected a number of porches at the sides of those edifices as for parish churches, after the 13 th century their principal as well as side doorways frequently open beneath porches.

At the end of the 12 th and beginning of the 13 th centuries, two porches, one on the north and the other on the south side, were placed before the secondary doorways of the Romanesque cathedral of Puy-en-Velay, and those two porches are surmounted by halls; but these are unusual, nowise harmonizing with the edifice to which they are added, while it is necessary to see in the lateral porches of the cathedral of Chartres concep-

conceptions harmonized with the monument already built. The N north and south porches placed before the transept doorways of the cathedral of Chartres justly pass for masterpieces. Th They were evidently composed by artists of the first order, and present one of the most beautiful specimens of French architecture of the middle of the 13 th century. Their plan, construction and ornamentation, the statuary covering them, are subjects of inexhauttible study, and their en irety presents that complete harmony so rare in architectural works. That on the north is richer in details, more complete in the entirety of the sculpture, perhaps more original in composition, and would produce more effect if it were erected on a grand flight of steps, like that on the south, and more exposed all d day to the rays of the sun. Originally, these two porches were painted and gilded; their appearance they must have been marvellous. When one examines them in their entirety and their details, these clear compositions, profitably studied and of erreproachable execution, one can ask himself if since then we have not forgotten instead of learning; if we are the descendants of those masters, whose fertile imaginations were s still subject to rules as rigorous as wise; and if there be not more art and taste in one of these masterpieces, than in most of the pale and cold monuments erected in our days.

The sum of the intelligence, science and knowledge of effects and practical experience expended in these two porches of Notre Dame of Chartres would suffice to establish the glory of an entire generation of artists; then the arts of architecture and of sculpture knew how to form an intimate alliance, and r remained closely combined.

We do not believe it necessary to give here illustrations of those porches published in so many works,[1] lithographed a and photographed many times. We shall pass to the study of e examples in less remarkable, but less known. The church of S. Nicaise of Rheims was built by the architect Libergier, who died in 1263;[2] this was one of the most beautiful religious monuments of Champagne. Wise in construction, the church S. Nicaise shows what tha architecture of Champagne became at the middle of the 13 th century, a mature art. On the facade of that church opened three portals; the central one on the axis of the great nave, and the two others on the axes of the

side aisles. We shall return immediately to these secondary doorways. The central doorway was preceded by a porch of small depth, erected between the two buttresses abutting the archivolts of the nave, and receiving the weight of the angles of the two towers. Fig. 27 shows us at A the outline of the plan of that porch with the scale in ft. From the axis of one buttress to that of the other counts 40 ft. The buttress had 3 ft. in front; one also counted 3 ft. for the opening of the arches B, and 16 ft. for the opening of the central arch; for the depth of the porch 4 ft., it being only a shelter. Thus the 4 isolated and engaged columns a,b,c,d, divided the distance a d into three equal parts, and these 4 columns bore three archivolts surmounted by gables. (See elevation G). Each archivolt circumscribed an equilateral triangle, and the two gables formed two sides of an equilateral triangle. If the central arch were entirely open, those of the two sides were half occupied by the thickness of the buttress, as shown by our plan at E and E'. As for the splay of the portal, it was arranged so that at K existed woodwork forming a framework or double doorway. At C is traced the section of the porch on 1 m. Fig. 28 gives the perspective view of the central porch of S. Nicaise of Rheims. Simple as is its plan, this composition had great richness in elevation, but without the details injuring in anything the entirety of the lines. At first the architect had the novel idea of giving to his porches the appearance of one of those decorations, that are arranged before the facades of churches on days of great ceremonies. Without opposing the principal structure of the architecture, these arches surmounted by gables form a sort of ornamental substructure occupying the entire width of the church, and pierced by openings at the doorways. This was like a wide scaffold all hung with tapestries; for one will note that the surfaces of this substructure are ornamented by fine fleur-de-lis in relief, that give the appearance of a fabric. Behind this light architecture, that seems erected for a festival, are seen the doors richly ornamented by reliefs. This central space, of which we give a perspective vieu (Fig. 28), bore on its mullion the statue of S. Nicaise; in its tympanum was Christ seated on the world at day of judgment, with the Virgin and S. John beside him with adoring angels; below at one side were the elect; on the other

the damned, some of which were drawn into hell in a wagon. In the spandrels, two angels sounded trumpets. The twelve apostles were not plated as statues in niches, but as groups of personages in the two recesses made beside the jambs of the doorway. One sees how, with an arrangement extremely simple in p plan, the architect Libergier knew how to produce a very ornamental entirety, easy to follow at a glance.[1] The two porches opening on the axes of the side aisles were each composed of a single arch pierced between the two great buttresses of the towers. This arch was surmounted by a gable, like those of the cenaral porch, and had an opening of 12.8 ft. But as these lateral porches were those generally used (the central portal being opened only for processions or to allow the exit of the multitude), their porches had a greater depth (6 ft.), and inside were placed permanent frames, very ingeniously arranged. The plan (Fig. 29) shows the arrangement of these frames at A, and the entrance of the stairs to the towers, an entrance also found outside the church, though protected by the external doors. The spaces A and B were covered by pointed t tunnel vaults, like the archivolts, and the tympanums of the doors were decorated by reliefs in the quatrefoils and lobes, like that of the central doorway. The surfaces D were likewise covered by scattered fleurs-de-lis in low relief. Libergier seems to have been at first of the idea of so treating p porches, as oddities, recalling the temporary works erected before the portals of churches on the occasion of certain solemnities. That idea was developed later with more or less good fortune, but without having surpassed this first attempt, it seems to us. Yet at Troyes in the same province there still exist two porches of a very remarkable arrangement before the doorways of the transepts of the church of S. Urbain.[1] These porches are actual canopies supported by flying buttresses transferring the thrust and the load of their vaults, to the e external isolated buttresses. The plan of one of these porches, entirely alike each other (Fig. 30), indicates this arrangement. The space A, B, C, D, is vaulted. These two vaults r rest on the wall of the transept and on three piers B, F, C. Three flying buttresses G, E, H, transfer the external thrust of these vaults to the three buttresses I, K, L. The lightness of this construction is surprising, built in lias from Tonnerre

of excellent quality. These two vaults actually have the appearance of a suspended canopy, for their projection scarcely allows to be seen the slender columns that receive them. As f for the buttresses I, K, L, in spite of their relative importance, they are so singular (the two buttresses I and L being opposite those at O and M of the church), that they do not seem to belong to the porch, and the eye does not stop there. At P, we have sketched at the scale of 1 : 20 one of the angle columns B, C, and at R is the detail of the pier S with its niche T at the same scale. A section made on X V (Fig. 31) takes account of this singular construction, whose elevation can give only a very incomplete idea. In perspective the buttresses and flying buttresses do not project as in the elevation, they separate from the porch, leaving it independenta For example, the flying buttress A,has an elongated plan and abutting the first buttress of the choir, does no participate in the construction of the porch;[1] the buttresses marked I and L in the plan seem to be attached to the church and not to the porch. There is in this composition an entirety of effect, that an elevation cannot render, and which with difficulty is expressed in a perspective view. But what must attract the attention of a architects in the porches of S. Urbain is the grandeur of the system. In spite of their excessive lightness and the slenderness of the different architectural members reduced to their weakest dimensions, these porches are grand in scale, and do not have the leanness with which one reproaches many edifices erected at the end of the 13 th and beginning of the 14 th centuries. The elevation made on the line a b of the plan (Fig. 32) fully shows how this composition is broad and clear, and how the details are subject to the masses. On the two lateral archivolts are erected the gables, as on the front; and the r roofs of slate follow the slopes of these gables, so that the water runs off by channels placed on the flying buttresses a and by gargoyles set before the buttresses (see section). Behind these roofs form a hip with a gutter, so as to relieve the great windows of the transepts. The gables indicate the form of the roofs, which is rational. Above the two doorways opened two windows under the porch, as shown by Fig. 32, windows with tracery skilfully combined with the open gables, t that surmount these two doorways.

Note 1.p.296. See Monographie de la cathedrale de Chartres, by M. Lassus. The work of M. Gailhabaud, l'architecture du Ve au XVIe siecle. Les eaamples de decoration of M. Goucherel.

Note 2.p.298. The tomb of the architect Libergier is now p placed in the cathedral of Rheims; before the demolition of the church of S. Nicaise, it was placed in that monument.

Note 1.p.298. The church of S. Nicaise was demolished since the end of the last (18 th) century. By ordering that demolition, the people of Rheims deprived their city of France of one of the most beautiful monuments of the 13 th century. Happily the documents on that edifice are not too few; there are plans and several engravings, among others that of the facade, which is a real masterpiece, and which is due to an engraver of Rheims named De-Son. That rare plate dates from 1625.

Note 1.p.300. We have had very frequent occasion to speak of this pretty church, which presents the most complete and most extraordinary development of thes architecture of Champagne in the 13 th century. (Arts. Architecture Religieuse! Construction, Figs. 102 to 106; Fenetre, Pilier).

Note 1.p.301. This is the flying buttress worked Y on the plan.

The construction of the porches of S. Urbain of Troyes is conceived like that of all other parts of that pretty edifice; i.e., it consists of great blocks of stone from Tonnerre forming an actual front for the archivolts, gables, balustrades, openings and turrets, with low courses for the buttresses. As for the filling of the vaults, it is made of small materials.[1] These porches, like the entire construction of S. Urbain, erected at a single spurt and dating from the last years of the 13 th century, is one of the boldest and wisest of the middle a ages. The 14 th century did not att in this lightness, and particularly this breadth of composition in the works of the same kind, that it had to erect. Thus the southern porch of the church of S. Ouen of Rouen, built about the end of the 14 th century, is far from having this ample and light appearance; it is heavier and is surcharged with details, that injure the entirety. The western porch of S. Maclou at Rouen is certainly one of the richest erected in the 15 th century, but it t takes all importance from a facade, and does not seem to have that special purpose so well indicated at S. Urbain of Troyes.[2]

The arrangement of the porch of S. Maclou still has this of i interest, that it lends itself to the form of the enclosing streets, and that its lateral arches form in plan two sides making very oblique angles with the central arch, to give the multitude of believers more easy access.

Note 1.p.304. For the system of construction adopted at S. Urbain of Troyes, see Art. Construction, Figs. 103 to 106.

Note 2.p.304. See the beautiful photographs of that porch made by Bisson Freres.

The church S. Germain l'Auxerrois at Paris possesses a porch from the beginning of the 15 th century that is perfectly conceived. It opens in front by three principal arches that comprise the width of the nave, and by two lower and narrower arches before the side aisles; a similar arch at each side gives lateral exits. The vaults over the two end bays are surmounted by two chambers covered by steep roofs and lighted by small windows opened in the tympanums compensating for the difference in heights of the great and small arches. A balustrade cr crowns this structure covered by a terrace below the rose window in the central part.

The sculpture and details of this porch, although often retouched and recently rubbed, lack character and are soft and poor. The porch of S. Germain l'Auxerrois is only good to study from the point of view of the entirety and of its happy proportions. The central doorway that opens into the nave partly dates from the 13 th century, and is the sole fragment of that epoch found in the entire edifice, rebuilt during the 14 th, 15 th and 16 th centuries. The system adopted in the construction of this porch appears to us to properly fulfil the conditions imposed by the needs of a great parish church, for which we present here (Fig. 33) its general view.

One will note that the end arches being lower than the middle ones, the believers gathered under that external vestibule, also deep, are perfectly sheltered from wind and rain, a although circulation is easy. Not as much can be said of porticos, peristyles or porches, claimed to be classical, established before churches built within two centuries. The peristyles of S. Sulpice, the Madeleine, S. Vincent de Paul, Notre Dame de Lorette, perhaps present a more majestic decoration, but they are an insufficient obstacle to the wind, rain and sun.

On the southern facade of the collegiate church of Poissy, one notes still the remains of a pretty church of the 16 th o century; but this appendage was rebuilt in 1821 and has lost its character. One of the most beautiful porches erected at that epoch is certainly that sheltering the south doorway of the cathedral of Alby.[1] This porch is an actual canopy supported on piers before the entrance of the church. It rises at the top of a grand flight of steps, formerly protected at its lower part by a fortified work, of which very imperfect remains are seen. We give (Fig. 34) the plan of the porch of the cathedral of Alby with the flight of steps preceding it and the front defense. The arches A and B open on a vast platform surrounded by crenelated walls. Fig. 35 presents a perspective view of this porch taken from the side of the steps.

Note 1.p.308. Art. Cathedrale, Fig. 50.

The porch of the cathedral of Alby is one of the compositions of the last schools of the middle ages, and produces a marvellous effect, built of white stone, is is detached on tone of the brick of the church and on the sky in the most picturesque manner; its position is so well drawn at the top of the long flight of steps, in fact being the most imposing entrance that can be imagined. Formerly a long and high glazed window opened over the gate and below the vault of the porch, and gave great light within the church, otherwise very dark.[2]

Note 2.p.308. M. Daly, diocesan architect of Alby, was recently charged with restoring this porch, and has acquitted h himself of this difficult task with remarkable talent.

In this Article we have been able to give all the examples of church porches that merit being mentioned; we have restricted ourselves to producing those presenting a really frank o character, that clearly emphasize their purpose, and whose composition offers the originality due to artists of talent. The churches of France are certainly those presenting the m most varied examples, those best understood and the grandest of the porches of the middle ages. In Germany they are rare; habitually low and small in England. But certainly nowhere in Europe, neither in Italy, Spain, Germany nor England, does o one see porches that can be compared even afar to those of Chartres, S. Urbain, S. Maclou, cathedral of Alby, S. Ouen of Rouen, and S. Germain l'Auxerrois.

PORCHES ANNEXES A DES CONSTRUCTIONS CIVILES.

Porches attached to Secular Structures.

Atricles Escalier and Perron give some examples of porches combined with the principal flights of steps of palaces and castles. On the public way it was impossible to place porches before the houses. These sometimes possessed continuous porticos or corbelled projections forming a shelter, or again actual permanent hoods. (Arts. Auvent, Maison). Porches properly so called would have obstructed passage, particularly in the cities of the middle ages, whose streets were generally narrow. Sometimes in the courts a pavilion resting its angle on a single pier formed a little porch before the entrance or the exit from an alley, as shown in Fig. 36.[3] At the angle of a public place or a crossing was also left in certain cases, or under a house, a covered area open on the public street; but these shelters were rather loggias than porches, and were placed near markets; they were rooms on a small scale, what are called exchanges today.[1]

Note 3.p.306. In Art. Maison, Figs. 36, 37, see the plan and elevation of the mansion de la Tremoille, the turret forming a porch for the ground story, at the entrance of the passage leading to the garden. Also see Art. Tourelle.

Note 1.p.309. Art. Loge.

Yet the vignettes of the manuscripts of the 15 th century frequently present quite important porches before mansions on the public street; and these porches are always represented as being relatively very ornamental. A beautiful manuscript of t that epoch belonging to the library of Troyes (No. 178) gives the porch of a mansion, whose plan and arrangement are given here (Fig. 37). The porch A is placed at the angle of the building and forms a vestibule inside. The perspective furnished by the manuscript is represented by our Fig. 38. This porch is very small in scale, and is only a shelter able to contain four persons. This suited the entrance of a habitation. Above the corbel supporting the springing of the front gable is placed one of those statues of the Holy Virgin, so frequen at the crossings of the cities of the middle ages and at the corners of streets.

But the form of porches most commonly adopted before civil structures, such as hospitals, leper hospitals, houses for a

assemblies of citizens, rural habitations, is that illustrated by our Fig. 39. These additions consist of side walls with s stone pillars on which wooden plates bear a ceiled carpentry structure, whose span was only retained bn raised collar beams. The lightness of this sort of structure would not have permitted them to come down to us, and if there still remain some of them, this is because they have been enclosed in the midst of more recent structures. In the countries of the North, Sweden and even England, men continued very late to build porches a according to this system; thus some of them are still standing, the more because the carpentry employed in these countries is much heavier than that used in France. It was also customary in Flanders to erect wooden porches before drawbridges of castles and manor houses, so as to place under cover the persons waiting to be allowed to enter; but with us this sort of structures always had the appearance of a little castle, or at least that of a defended post.

We have given only a small number of the examples supplied by the porches of the middle ages compared with their abundance, for these additions must be erected on programmes not uniform, and it was natural to vary their appearance, as well as their construction and general arrangement. There are many important porches that we have mentioned, and that require an entirely special study; such are the porches of Notre Dame of Chartres, the cathedral of Bourges, S. Vaclou of Rouen, the church of Louviers, and among the much older porches, those of S. Front of Perigueux, the churches of Auvergne, Notre Dame des Doms at Avignon, etc. As for additions before doorways, t that because of their small projection, or rather because of their intimate connection with the edifice to which they belong, for us cannot be regarded as porches, we class them as p portals.

PORT. Port. Harbor.

There remain to us but few traces of the maritime ports established during the middle ages. The arrangement of the ports changed continually because of the developments of commerce, and one must not be surprised to no longer find ports dating several centuries since, and entirely preserved. Yet from the 11 th century the shores of France possessed very important ports. Without mentioning the ports of the Mediterranean, which

like that of Marseilles dated from a very distant epoch, one also counts from that epoch those of Frejus, Agde, Narbonne a and Antibes, which could contain a great number of ships. Everything leads one to believe that the ancient port of Marseilles, still utilized during the middle ages, occupied the place of the old port of that city. On the coasts of the Atlantic, there were in the 12 th century ports at Bordeaux, R Rochelle, the mouth of the Loire, Brest, and in the channel at S. Malo, Granville, Cherbourg, Caen, Dieppe, Boulogne and Wissant.

These ports were mostly enlarged and protected by important works during the 13 th and 14 th centuries. One still sees at the entrance of the ports of Marseilles one of the towers, t that defended the inlet of the port, and that dates from the 14 th century. At the entrance of the port of Rochelle also exists a beautiful tower, whose substructure is very ancient, and whose upper part dates from the 14 th century, and which defends the channel. It is connected with a work built on the other side of the inlet closed by a sort of portcullis. M. Lisch, architect, has discovered very interesting traces of these defenses, and should make them the subject of a work to be published. The same city possesses a beautiful lighthouse dating from the 14 th and 15 th centuries, which is still entire, although no longer employed for that purpose. At Aigues-Mortes, king Louis IX first established at the entrance of the port, that served him as a base of operations for his expeditions beyond the sea, a very important tower crowned by a fire, and that is known today by the name of the tower of Constance.

Ports were closed during the middle ages by chains, and sometimes by portcullises suspended between two towers separated by the channel. It must be stated that at that epoch the ships of the largest tonnage had only 19.7 to 23.0 ft. breadth of beam.

The use of piers was then habitual, as it is in our days, e either to protect passage in storms or to maintain the depth of the channel and prevent it from filling with sand. The substructures of the western pier at Dieppe are very ancient and existed before the 16 th century, since at that epoch this p pier was partly rebuilt. But the small resources then at dis-

disposal por undertaking expensive works, now so common, when permitted by the location of the shores, caused that men profited by the mouth of a river or a pond in building a port; a and then at need was established a channel of communication with the sea, when as frequent for salt ponds, the natural i inlets were shoaled by sand or entirely closed. Thus the ponds forming the port of Aigues-Morts were placed in communication with the high sea. Thus S. Louis caused the canal of Bouc to be dug near Marseilles to allow ships to enter the pond of Berre.

PORTAIL. Portal.

Splays or stepped recesses arranged externally before the principal doorways of churches to form a shelter. What distinguishes the portal from the porch, is that the portal unlike the porch, does not present a projecting structure, but belongs to the doorways themselves. Although the doorways of the cathedrals of Paris, Bourges, Amiens, Rheims, Rouen, Sens and Senlis, are sheltered by deep arches even surmounted by gables, as at Amiens and Rheims, still one cannot give those projections the name of porch.

The portals of our great churches furnished the architects of the middle ages with splendid motives of decoration. They are habitually ornamented by numerous statues, figures and reliefs, on the splayed jambs, the voussoirs, and in the tympanums over the doors. This arrangement of the portals of churches belongs to our country, to the architecture coming from Ile-de-France in the 12 th century, and certainly one recognizes in it the mark of a true and grand feeling for decorative art. To surround thus the principal doorways of churches by a world of statues and reliefs, sometimes forming a series of dramatic scenes, is a bold and novel idea that produces a grand effect, for one cannot furnish a place more favorable to statuary. The oblique splays, lighted by the sun in the most varied manner, give to the sculptures a relief, that seems to lend them life. Thus most of those grand portals, such as those of Notre Dame of Paris, Rheims, and Amiens, form real poems in stone, that always attract the attention of the multitude. (Arts. Cathedrale; Porte).

PORTE. Gate. Gateway. Doorway.

An opening at the level of the ground and serving for passage. Every gate is composed of two piers and a lintel or an arch. The jambs have a sill and rebates intended to receive the leaves or gates. We shall divide this Article into fortified gates of cities and castles; doorways of keeps and towers; gates of abbeys; doorways of churches, external and internal; doorways of palaces and houses, external and internal.

PORTES FORTIFIEES TENANT AUX ENCEINTES DE VILLES; CHATEAUX; MANOIRS.

Fortified Gates belonging to Walls of Cities, Castles and Manor Houses.

There still exist in France some Roman and Gallo-Roman gates, that present the character of a passage pierced in a wall and protected by defenses. Such are the gates of Nimes, Langres, Arles and Autun; the former preceding the establishment of Christianity; those of Autun dating from the 4 th or 5 th centuries. These gates are all arranged on nearly the same plan. They consist of two passages, one for the entrance and the other for the exit of vehicles, with two passages for persons on foot; they are flanked externally by two principal towers forming pronounced projections. The gates of Arroux and of S. Andre at Autun are surmounted by an open gallery for defense, over the two arches affording passage through the wall, and that can serve for defense at need. The openings are on the public street and were only closed by wooden leaves, without portcullises and drawbridges.

Note 1.p.311. The traces of portcullises appearing in the piers of these gates date from the middle ages.

Gate S. Andre at Autun is the most complete of all that we possess in France, and approaches the epoch of the middle ages.[2] It is further entirely designed on the antique model and has two entrances A (Fig. 1), two openings for persons on foot B, two towers C serving as military posts, with their two stairways D ascending to the upper stories.[3] One still finds on the road at A numerous fragments of that Roman pavement in great irregular blocks. At the two posterns B were established sidewalks, and at E was excavated a wide ditch, whose section may yet be seen. The road formed a causeway that extended quite far into the valley, as if to show those arriving. The p

The principal work (Fig. 2) is built of great blocks of sandstone set close without mortar according to the Roman method. In our Fig. 2 is seen the upper defensive gallery pierced by arches and communicating with the second story of the towers and the defensive gallery of the curtains. Those towers also possessed two other stories above and reserved for defense, one covered by a vault, and the last open to the sky. Men ascended there by the stairs with double flights indicated on the plan.

Note 2.p.314. As we have stated above, this gate does not seem to date before the th century.

Note 3.p.314. The tower at the right alone exists up to the level of the top of the gate, but its stairs has been destroyed, and its traces are no longer visible.

We have been frequently asked when seeing the gates of the cities of Pompeii, Nimes, Autun and Treves, all so well arranged for the entrance of chariots and footmen, why men since pretend to return to the forms of Greek and Roman antiquity, they have never adopted this natural system of twin openings? The reply to that question is, that there is a sort of conventional antiquity, whose imitation they pretend to require. To place a pier in the middle of a street would seem to permit a an enormity in the eyes of persons, that have thus falsified the spirit of antiquity. Many honest men regard the gates S. Denis and S. Martin at Paris, so little intended for the passage of carriages, as being what is conventially called a happy inspiration in accordince with the rules of an iquity. But for the honor of the antique art neither Romans, Byzantine G Greeks no Gallo-Romans ever erected such badly arranged city gates. Their gates are wide, double, and never have a height below the keystone greater than that of a very heavily loaded wagon. They are accompanied by posterns or smaller gates for persons on foot and are deep, i.e., forming a passage quite long, more than that for the openings for wagons, to permit a necessary stoppage. Sometimes these posterns are even accompanied by benches and arches opening on the passage for wagons. For example, such is the arrangement of the gate of Augustus at Nimes.

The towers and ramparts adjoining the gate of S. Andre of Autun are built of concrete faced externally and internally

by a facing of little cubes of rubble according to the Gallo-Roman method. Although the details of this gate drawn and executed but moderately, the entirety of this structure and its proportions produce the most happy effect.

But one conceives that these gates were not sufficiently o covered, closed and defended to resist a regular attack. It is true that in time of siege, there were established before these entrances works of earth and wood, a sort of barbican that protected the wide gates. Those works of earth with ditches and palisades sometimes extended very far into the country, forming a vast triangle with the rampart of the city as base, and whose apex was protected by a tower or post of masonry. Even at Autun, on the other side of the river Arroux, is one of those great triangular works of earth, whose two sides end at two bridges, and whose apex was protected by a great square work of masonry, known today by the name of the t temple of Janus, and that in reality was only an important p post holding the important point of the bridgehead. What remains of that square tower fully shows that it was without gates at the level of the ground story, and that one could only enter there by an opening made in the second story, and by me means of a ladder or a movable wooden stairs.

When Gallo-Roman soil was invaded by hordes from the northeast many open cities were fortified in haste. They destroyed the great monuments, temples, amphitheatres, to build ramparts with gates flanked by towers. One still sees at Vesone (Periguex) near the old cathedral of the 10 th century one of those gates. Not long since they still existed at Sens, Bourges, and in most cities of the East and Southeast on Gaulish soil. Many of those works were built of wood, as for example at Paris.

When later the Normans threw themselves upon the country under the rule of the Carlovingians, the cities must again establish in haste the external defenses to resist the invaders. These works must have had no great importance, for it does not appear that they opposed very serious obstacles to the assailants; contemporary reports also generally present them as having been built of wood; and further the art of defense of p places had not had opportunity to develop under the first Carlovingians.

Only with the regular establishment of the feudal system was

that art elevated to the point, to which we see it arrived during the 12 th century. The remains of the gates of the walls of cities or of castles preceding that epoch, always modified later , however indicates already a well understood defensive arrangement. These gates then consist of round-arched openings allowing just one wagon to pass, i.e., they have scarcely 9.8 ft. in width by 9.8 to 13.1 ft height under the keystone. It was then no longer a question, as in cities built during the Gallo-Roman epoch, of opening wide gateways to commerec, to those going or coming, but on the contrary to make the openings as narrow as possible in order to prevent surprises, and to be able to guard them easily. Great and strongly projecting towers protected these gates.

We find no complete example of gates of cities or of castles before the beginning of the 12 th century. One of those examples, coming down to us without any alteration, is seen at the castle of Carcassonne, and it dates back to about 1120. We g give (Fig. 3) the plan of that gate in the ground story. One reaches the entrance by a bridge defended by a great barbican built in the 13 th century.[1] The floor of that bridge A, whose parapets are crenelated,[2] is interrupted at B, and leaves before the entrance a ditch about 9.8 ft. long by 9.8 ft. wide. A movable floor, raised in case of siege, covered this void. The gate is only 6.6 ft. wide by 7.5 ft. high, and is surmounted by wide machicolations and closed by a portcullis C, a door D and a second portcullis E. A post placed in the hall F of t the left tower had its entrance at G under the passage. A second post H was placed in the right tower, and had its entrance under a portico opening on the internal court of the castle. At K is a very wide ditch. Slots arranged in the two rooms F and H command the entrance and the exterior. One could ascend to the upper stories of this gate only by wooden stairs placed along the internal surface of the work at I. The plan (Fig. 4) is taken at the level of the chamber O of the second portcullis falling in the grooves P also forming machicolations. Two square holes R are pierced in the floors of the two rooms in these towers and pass through the vaults of the rooms of the ground story, and correspond to two other holes pierced in the vaults of the second story, so as to place in communication the defenders posted in the upper story with the men serving the second portcullis and with the men of the lower posts.

Those holes are 2.1 ft. long by 1.6 ft wide and even allow placing ladders in case of need. But they were pierced especially to facilitate command, that was always given from the upper part of the defenses. Fig. 5 presents the longitudinal section of the gate made on the axis. One sees at B the interruption of the floor of the bridge; at C is the chase for the first portcullis, and at D the chase for the second. The first portcullis is worked from the upper story at F, placed directly under the floor reserved for the defenders. The second portcullis is managed from the chamber, whose plan we have given. (Fig. 4). The holes for the wooden defensive gallern are visible at G.[1] Before the first portcullis is arranged a great machicolation; a second machicolation is pierced before the second portcullis. At H we give the section of the chamber of the portcullis made on the line a b c d of the plan (Fig. 4), with the vaulted halls of the ground and second stories. The section (Fig. 5) also shows the wooden stairs, that permit ascent from the court of the castle, either to the chamber of the portcullis or to the upper story. A first wooden gate was placed at I on the bridge before the ditch, to command the floor of the bridge from there. That space before the first portcullis was sheltered from arrows, that might be shot by the a assailants, by a little shed roof; also allowing to pass the projectiles falling from the first machicolations. Thus in c case of attack, a guard posted on the movable floor covered w with projectiles the fixed floor of the bridge. If one foresaw that the gate I would be forced, the movable floor was d dropped. From the top of the tower could easily be seen the arrangement for the attack, the portcullis was dropped and the door behind it was closed, and at need the second portcullis was ordered to be dropped. Then the entire defense was made from above, either from the wooden galleries, by the slots, or by the great machicolations. If desired to take the offensive and make a sortie, from the top came the order to raise the second portcullis, the men were massed in the gate passage, a foot-bridge was prepared, the portcullis was raised and the door was opened. If repulsed, they sometimes returned with the enemy behind them, but not dropping the first portcullis, the most advanced assailants were separated from the column massed on the bridge, and they were made prisoners.

Note 1.p.319. Art. Hourd, Fig. 1.

Fig. 6 is a perspective view of the gate taken from the bridge, assuming the wooden defense and its shed to be removed. On the flanks of the towers are seen the two corbels intended to support the rear beam and its shed roof. The first portcullis is assumed to be removed and the ditch is not covered by its movable floor. Except the portcullises, that are omitted, but all their attachments and more of suspension are visible, this gate has suffered no deterioration. It must be added, t that the ditch has been replaced by a modern vault. This structure is made of small blocks of yellow sandstone, and is e executed with great care. The rooms are covered by domes of well cut robble- the roofs covering this entrance have recently been rebuilt in the form indicated on the longitudinal section.

The means of attack of strong places of that epoch adopted, means only consistent with a sap, very lengthy and dangerous since it was impossible to breach by battering the towers and curtains, whose walls had such great thickness, caused that t the assailants always sought to attempt an assault or to surprise the enemy. Id the towers and curtains projected too much to make it possible to attempt scaling, especially when the parapets were equipped with wooden defensive galleries, they attempted to enter the place by surprise or by a sudden attack on the gates. Hence the besieged accumulated means of defense at the gates; the portcullises were doubled, doors and obstacles, and the windlasses of these portcullises were separated, so as to render treason more difficult. Thus in the example j just presented, one sees that the first portcullis is worked from the top, i.e., where all the defenders of the gate are collected, where there is necessarily found the captain. The men charged with this work being thus surrounded by most of the post, and under the eyes of the commandant, could betray it with difficulty. The chamber of the second portcullis is entirely separate from the first windless. The men charged w with working the second portcullis could not see what passed outside, and could have no understanding with those posted at the first windlass. They could even be shut up in that chamber. Thus were avoided chances of treason; for it must be stated that these defenders like the assailants of a place were

enlisted everywhere, and those troops of mercenaries were disposed to sell themselves to the best bidder; many places were taken by treason of a post, and all arrangements by military architects must tend to prevent relations of posts charged w with working the closures with the outside, to isolate them completely or to place them under the eye of the captain.

Surprises of places by the gates were so frequent, that not only were obstacles multiplied, the closures in the length of the opening, but outside were also placed barbicans, advanced works that made approach difficult, that compelled those entering to make detours, and cause them to pass several posts.

Today, when a place is regularly besieged, the first parallel is established at 1970 or 2625 ft., then gradually proceeding to the point of attack by tranches, breaching batteries x are established as near as possible to the counterscarp of t the ditch; the besiegers with artillery pay little attention to the gates, except to prevent the besieged from using them to make sorties. But when the attack on a place could be serious only at the moment when the miners reached the ramparts, one conceives that the gates became weak points. The definite attack being extremely close, every opening and exit must incite the efforts of the besieger.

In studying the fortified gates of places in the middle ages, it is then very important to recognize the exterior and to se-seek traces of the advanced works protecting them; for the g gate itself, however well fortified at was, is always nearly a last defense preceded by many others.

The gate Laon at Coucy-le-Chateau, from that point of view is one of the most beautiful conceptions of military architecore of the commencement of the middle ages. Like the ramparts of the city and the castle itself, entirely built at the beginning of the 13 th century by Enguerrand III, lord of Coucy,[1] it gives entrance to the city opposite the plateau that extends from Laon. This gate is placed opposite the tongue of land that connects the plateau to the city of Coucy, and gives entrance into the city nearly on a level; but because of that situation itself, it requires to be well defended, since that tongue of land is the only point by which one could attempt to attack the ramparts, dominating considerable precipices around the rest of its perimeter. At the beginning of the 13 th cent-

century, here is a defensive system of the approach to the gate. (Fig. 7).

Note 1.p.322. The gate Loon at Coucy is of a date a little earlier than the construction of the castle. Naturally the wall of the city must precede the erection of the castle and the famous keep; this gate by its style and structure belongs to the first years o the 13 th century. Enguerrand III took possession of his domain abouh 1183 and died in 1262.

At A was traced the road to Laon, now transferred to B; at C was a road descending into the plain and going toward Chauny.[1] At D was a great barbican in which united the two roads to reach a viaduct E, admirably built on pointed arches. This viaduct ended at a tower G, built on the axis of the gate H. From the junction F of the two roads to the point E, this viaduct rises in a sensible slope toward the city. It was level from the point E to the threshold of the gate, and from that threshold to the point H, there also existed a slope beneath the entrance passage. From the lowe rooms of that gate by first a subterranean tunnel pierced under the passage, and by openings pierced in each pier of the viaduct, one reached the level D of the barbican beneath the upper road. Thus from the city and without opening any of the portoullises and doors of the gate itself, without lowering the drawbridge, and without opening the doors of the openings of the tower G, the defenders could spread in the enclosure of the barbican, could go to the exits L and K, to the corner tower P and on the raised defensive walks with palisades. If the barbican were forced, the defenders could return to the city under the viaduct, without being obliged to open the leaves of the gates of the to tower G, or the portoullises of the principal work; Later, a about the end of the 15 th century, the beautiful faced rampart still entire was constructed on the site of the tower G, whose substructures thus remained in the middle of the terrace; the viaduct was maintained and partly enclosed within the masonry of the rampart. The plan (Fig. 8) gives the entirety of these successive constructions. This plan is taken at the level of the lower story of the gate. One descends from the city by two stairs A into two low halls B, and from those halls into the subterranean tunnel C. The length of the viaduct is followed over the drawbridges D between the piers, to the gr-

great barbican and passing through the lower story of the tower G. We shall soon see the detail of the part of this passage with the gate, and of the drawbridge placed at E. Our plan gives in lighter tint the rampart built about the end of the 15 th century, and which is of great interest for the history of defenses applied to artillery.[1] Then the engineers used t the subterranean passage to reach the lower galleries and that rampart. They only closed the arches I by masonry and filled the passage to the drawbridges. At the bent part the viaduct only served as a bridge crossing a ditch to reach from t the plateau to the level of the platform of the rampart.[2] The spaces K formed a ditch separating the plateau from the city and descending at right and left to the natural precipices. The lower galleries of the rampart are indicated on the plan, and were pierced by numerous slots covering the bottom of that ditch with cross fires. This view of the entirety of the defenses of the gate Laon at Coucy very clearly shows the importance of thi military post, and how it was powerfully defended. Let us now examine the gate itself, sufficiently well preserved today that one can judge of the system adopted by the constructors.[3] The plan (Fig. 3) is taken below the pavement of the city, so that the floors of the two rooms forming cellars without vaults and of the two circular rooms V are a above the level of the bottom of the ditch K. These rooms were intended to serve as storerooms, and men descended into them only through two traps opened in the floor and in the recess P.

Note 1.p.323. That road is still visible.

Note 1.p.324. Art. Meurtriere, Fig. 11.

Note 2.p.324. We have only vague information concerning the tower G, now buried in the rampart beneath the present road to Laon, not having been able to make extended excavations. As for the viaduct, it is complete and is apparent in the middle of the additions of the 15 th century.

Note 3.p.324. This gate was terraced in the 15 th century at the time of the religious wars, to be able to place artillery at the tops of the towers. Those fills were removed several years since by the care of the commission of historical monuments, and that removal allowed one to discover the original arrangement, which we present in this series of engravings.

Fig. 9 gives the plan of the gate at the level of the pave-

pavement of the city. This plan shows the passage for wagons and footmen, narrowing toward the outer entrance.

This passage has a pointed tunnel vault at A, B and C; it i is covered by a floor at D. The entrance F is closed by a raised bridge G, and at I was a door in two leaves with bars. F From the corridor D one passed toward the city through side doors into two halls J, serving as guard rooms. One will observe that the two entrances into these halls from the passage are arranged, so tha one cannot see th interior of the posts, nor consequently determine the number of men contained in them. Those posts are warmed by two fireplaces K and are lighted by two windows L placed over the two descents to the cellars mar- K on the subterranean plan. From those two posts J one passed into the circular rooms M, each pierced by three slots, two on the ditch and one on the passage.

At N is one of the traps opening into a shaft corresponding to the cellar story. Two stairs are made in the thickness of the walls of the towers to permit one to ascend to the second story, whose plan (Fig. 10) presents an arrangement perhaps unique in the art of fortifying gates in the middle ages. The two stairs just mentioned land at A in two passages opening into the defensive galleries B of the curtains and into the circular rooms B. From those round rooms one ascends by two stairs D to the machicolations M pierced between the two portcullises. The round rooms are each pierced by three slots looking outward,[1] and by a window F looking on the city. They are further furnished with fireplaces C. By the corridors E o one either reaches the great hall S, lighted by 5 windows next the city, or the screw stairs that ascend to the upper defenses. Privies are arranged at L and a vast fireplace opens at X. One will agree that these arrangements, either as defenses or as posts, are remarkably extended. The great hall S being 72.2 ft. long by 26.3 ft. wide, could serve as a dormitory or assembly hall of a guard of 25 men, without counting the defenders watching in the posts of the ground story and in the three stories of the circular rooms. Thus a post of 50 to 60 men could easilo stay in this work in ordinary times, and in case of attack it would be easy to double that number of defenders without encumbering it. If one continues to ascend the two screw stairs, he reaches the second story (Fig. 11), and

enters either the two circular rooms A or the two turrets B, giving admission to a crenelated defensive gallery C on the city side, and allowing the defenders to watch the vicinity of the gate inside. The halls A are each pierced by two slots and a window F, communicating with the working of the portcullises at H and the defensive gallery at D by two passages G. Again ascending the screw stairs one reaches the fourth story (Fig. 12), which is the story particularly devoted to defense. By the corridors A one enters the round room B, passes into the defensive galleries furnished with wooden galleries C, or the inner defensive gallery P. From the circular rooms, or fr from the outer defenseve gallery C, one reaches the working of the drawbridge located above the outer gallery protecting the gate.

Note 1.p.327. Art. Meurtriere, Fig. 6.

Making a section on the axis of that gate, i.e., on the line a c of the last. Fig., one obtains Fig. 13.

This Fig. indicates the principal arrangements of that work. A is the ground of the city. One will note that the floor of the passage is very much inclined toward the entrance to give more strength to a column of defenders opposing assailants, that have been able to cross the bridge and raise the portcullises. At B is seen in section the subterranean passage ending at the exit postern C, that is placed in communication with the passages made through the piers of the bridge. A drawbridge is hinged at C and fitted with a counterpoise, when dropped allows one to descend the stairs D. From that point it is necessary to work a second drawbridge to pass the spaces E, F, between the piers D, G, H. And thus either by drawbridges or by plank foot-bridges, that can easily be removed, one passes through the tower G of the general plan (Fig. 7) and reaches the great bastion D. The floor I of the bridge (Fig. 13) was interrupted at J and replaced by a drawbridge, not combined like those of the end of the 13 th and succeeding centuries, but composed of a floor hinged at K, two timbers hinged at L, and two chains passing through the machicolations of the outer defensive gallery M; then these chains each divided in two parts, one coiled on a windlass and the other terminated by a weight. It was then at the level of the wooden defensive galleries that the drawbridge was worked, i.e., above the machi-

macnicolations M of the gallery. As for the two portoullises, they were managed from a single windlass; the chains coiled in inverse directions on this windlass, by means of a very simple mechanism, permitted raising one of the two portoullises before the other, but never together. It sufficed for that, when the portoullises were lowered and consequently no longer pulled on the windlass, to unhook the chains of the portoullis that one did not wish to raise, then turning the windlass in either one direction or the other. One of the portoullises being raised, it was fastened, its chains were unhooked and those of the second were attached, then turning the windlass in the opposite direction. It is unnecessary to say that the counterpoise facilitated raising it as always. To lower the portcullises, the chains were hooked on and one of the portcullises was allowed to run down gently by the windlass, then the other. The absolute order that only one of the two portcullises should be raised at a time was another security, and we have seen this system adopted only in this work.

But it is necessary to examine in detail the mechanism of the bridge and of the portoullises.

At A (Fig. 14) we give the plan of the chamber for raising the portoullises to the level a of the section, and at B is the plan of the platform for raising the bridge, at the level b of the same section. One will first note that the interval separating the two towers, and which covers the entrance, gives in plan a part of a circle. Two corbels c project on this portion of the cylinder and support a wooden defensive gallery d, fragments of which exist in place. This gallery was placed on two horizontal timbers e, and consisted of a wall of thick timbers E represented in section. At each side on the sides of the towers were fixed two pullies F intended to direct the two chains of the bridge, and to prevent them from r rubbing against the gallery or the masonry. Above these pulleys at G the chains divide in twio branches; one at H coils on the windlass T by means of a directing pulley n, the other at I was stretched by a counterpoise K. Turning the windlass from f to g rolls up the chain and raised the drawbridge. That work was aided by the counterpoise K. When this weight had descended to l, the bridge was completely raised. To lower it the wi windlass was turned in the opposite sense. On the plan B is

indicated the position of the windlass, and by dotted lines the horizontal position of the chains; the carpentry truss b being placed at m on this plan. A second machicola ion existed at p. To work the two portcullises, there were placed at right and left two tuin beams n (see plan B) on cross beams, (See the section), themselve resting on two corbels s (see pana A). Those twin beams each received two double pulleys t t', t being intended to receive the two lifting chains and t the counterpoise of the outer portcullis; t'for the lifting chains and counterpoies of the enner portcullis. The section shows the windless V with the attached lifting chain of the inner portcullis, the portcullis O being raised and consequently its counterpoise is lowered; the lifting chain of the outer portcullis being unhooked, which is lowered with its counterpoise R at its highest point, the two lifting chains coiled on the windless at X, (see plan A), the cranks being f fastened at Y. The construction being preserved today up to the level N, the fastenings of the corbels are visible, and for the upper part we have found fragments, that sufficiently indicate the details.

Nothing in this mechanism is more than very primitive; but what is important to note here is, that these arrangements so perfectly appropriate for the needs, and then even retaining a monumental appearance, that certainly has not been sought. It is evident that the architect authors of such works were subtle men, that reflected maturely on what they had to do. At all points the passages and exits are placed exactly in view of the service of the defense, have only the widths and heights necessary, and the architecture is indeed only the exact expression of the programme. Yet on the exterior the appearance of that defense is imposing, and recalls under another form those beautiful antique structures of primitive peoples.

Fig 15 gives the external elevation of the gate Laon at Coucy, the bridges being assumed lowered and the portcullises raised. The wooden defensive galleries of this work were evidently permanent and supported on stone corbels, like those of the keep of the castle.

The entire masonry is built in courses of limestone from the basin of the Aisne, of excellent quality. Roughly dressed, th those courses are separated by thick mortar joints, and the

rude appearance of these surfaces also adds to the effect of this grand structure. When one compares these works of Coucy, the keep, castle, the gate Laon, the ramparts and towers, to the works similarly erected about the same epoch in Italy, Germany and England, then he can recognize among us the hands of a powerful people, endowed with spirit and rare energy, a and one asks with some sadness how it happens tha those beautiful and noble qualities are scorned, and that the narrow and exclusive spirit could be able to repudiate such works by casting theg into the limbo of barbarism?

A transverse section made on the axis of the towers on the passages opened on the machicolations and on the room for raising the portcullises (Fig. 16), shows the interiors of the circular rooms in these towers, the passage A on the defensive galleries of the curtains, the section B of the wooden defensive galleries, and the entire system of defense of the interior.

A last Fig. will complete this entirety, on which one could publish a volume; this is the elevation of the inside facade of the gate next the city (Fig. 17). The wide arch with doubled voussoirs, that gives admission to the passage has a grand effect. The great hall of the second story is well accented by those 5 rectangular windows with mullions, and the two angle turrets abut this simple str cture in the happiest fashion. This facade is crenelated at top and shows very well that the gates of places well defended could actually take the places of small citadels and defend themselves at need against the citizens desiring to capitulate in spite of the garrison. Then the gate is always an isolated post commanded by a sure chief, and also able to resist in case of treason or of scaling the rampart. We emphasized in Art. Architecture Militaire the importance of these isolated posts in the defensive system o the middle ages, and it does not seem necessary to return to that subject here.

Leaving aside for the moment the works of less importance but of the same epoch, i.e., of the beginning of the 13 th century, we shall examine how in the space of a century, these arrangements could be modified in the construction of gates of like strength.

On the eastern side of the city of Carcassonne exists a gate

defended in a formidable manner, and designated by the name of gate Narbonne.[1] That gate and the entire work attached thereto were built by Philip the Bold about 1285, when that prince was at war with the king op Arragon.

Note 1.p.338. Art. Architecture Militaire, Fig. 11; also Archives des monuments historiques.

We present (Fig. 18) the general plan of that entrance with its barbican and its surrounding defenses.[2] Gate Narbonne is indicated at E and has no drawbridge; it opens on a level with the exterior, following quite a steep slope from outside to inside, and according to the defensive method of these w works. Movable bridges only exist at B on piers crossing a wide ditch outside the barbican A. After traversing that bridge, the comer presents himself obliquely before the first entrance C of the barbican, closed only by folding doors. That entrance C was flanked by a fort D of the outer enclosure, that completely commanded it. Another redan L with a strong turret on t the internal rampart, commanded outside that entrance C within reach of corssbows.[3] Turning to his left, the comer found himself before gate Narbonne defended by a chain, machicolations, portcullises, folding doors, a great internal machicolation G, a third machicolation I, a second portcullis and wooden doors. Two slots H are pierced in the passage between the two portcullises, and belong to two rooms F in the ground story, that are entered by the doors V. Those halls are each still pierced by five slots. The attackable part of the towers of the gate is reinforced by spurs or beaks N, each pierced by a slot O. We have explained elsewhere [4] the special purpose of those s spurs, or beaks. They compelled the assailant to keep away from the tangent, and placed him undan the arrows of the besieged. They neutralized the effect of the battering rams on the only point at which the besiegers could work them with success. To pierce the point of this beak by slots on a level with the external ground was also one means of preventing a close attack.

Note 2.p.338. This plan is at the scale of 1 : 500.

Note 3.p.338. Art. Echouguette, Fig. 6.

Note 4.p.338. Art. Architecture Militaire, Fig. 24.

From the rooms F two screw stairs ascended to the second story, from which men worked the portcullises. Under those rooms are maed fine cellars for provisions.

Wooden palisades P prevented free passage from the lists b between the outer and inner ramparts, and did not allow approaching on foot the inner curtains at M and K. The patrols co-could only pass by the barriers N to perform their night service. An enormous tower is indicated at the bottom of our Fig. and is called the tower of Treaau,[5] it commanded these lists and also served as a support for the gate Narbonne by striking the exterior over the external enclosure.

Note 5.p.336. Art. Construction, Figs. 149, 154.

Fig. 19 gives the plan of the second story of gate Narbonne. The two screw stairs that we have seen indicated in the ground story and in the two rooms A. These two rooms are vaulted like those of the ground story and each has a fireplace C with oven. From these two halls one can leave by the two doors B on the defensive gallery D, rising to the level of the terraces E of the curtains by great flights of steps. By the two passages G one enters on a level the central hall F, in the midst of which opens the great square machicolation I. Assuming that the assailants have been able to penetrate to the s second portcullis by forcing the first obstacles, on could overwhelm them wit projectiles and burning materials; the defenders charged wit that office remained behind in the recesses K, and thus were perfectly sheltered from the arrows, that could be shot by the enemy, or protected from the smoke and flame of the materials piled in the passage. By the two bent passages L the besieged passed to the front machicolations M. From that room F was worked the first portcullis N, and men served the third machilocation O. Continuing to ascend the stairs H from the second story, one landed nowhere but reached a precipice, so that assailants having been able to penetrate into these stairs in the ground story found the doors closed and barred in the second story, and continuing to ascend the steps to reach the upper story, found themselves caught in an actual mouse-trap. To ascend to the third story, t that of the defense, it was necessary to cross the rooms A and to seek the screw stairs R, that alone ascended to the battlements. To serve the second portcullis, it was necessary to p pass the doors B and to reach the plaform P. The servants of that second portcullis received orders from within by a little window pierced above the machicolations O. The two rooms are

pierced externally, one by three slots and the other by four, and lighted by two windows in the side next the city. This description sufficiently makes known the minute care devoted to the establishment of this gate. But the longitudinal section made on a b, that we present (Fig. 20), will make this description even clearer.

That section shows at A the chain suspended at one side of the gate from a ring fixed to the side of the tower and passing into the other tower through a hole and held by a bar inside, when one wished to stretch it. The chain was an obstacle employed in ordinary times, when the portcullises were raised and the doors opened, to a troop of cavalry that might wish to throw itself into the city. Even in time of peace, men feared and had reason to fear surprises. At B is the first machicolation pierced before the portcullis and shown at V on the plan of the second story. At C runs the first portcullis, served in the square central chamber. At D is the first wooden door with one leaf, ironed and barred, as shown in the Fig. At E is the slot commanding the passage, and above is the great square central machicolation with one of the recesses described in the preceding Fig. At F is the third machicolation pierced before the second portcullis; at G is that second portcullis worked from the outside and sheltered by a hood P. Finally at H are the last doors. From the room in the third story by the opening I could be directed the working of the portcullises; for it must not be forgotten that command was exercised from above. A formidable system of double machicolations in wood and of wooden defensive galleries further defended the approaches to the gate in time of war. The fastenings of that carpentry work are perfectly visible today. Then in case of siege were established before the machicolations R double defensive galleries with the first machicolation X and a second machicolation L. This double wooden defensive gallery was covered and crenelated for arches. It formed a h hood over a niche in which is placed a very pretty statue of the Holy Virgin. One can descend into that double gallery only by the opening N and ladders, so that of these galleries were taken by scaling or burned, the assailants would then not be masters of the defense. In the upper part we have drawn the wooden defensive galleries are paled. The entire

active defense is organized on the upper story M, the story O only serving for deposits and as a hall for collecting the g garrison. That hall O is abundantly lighted by beautiful windows in the side next the city.[1] We give (Fig. 21) the plan of the upper story M, whose floor was of wood. N N is the defensive gallery, and at X a part of the wooden defensive gallery is in place.[2]

Note 1.p.339. Art. Fenetre, Fig. 40.

Note 2.p.339. This plan is at 1 : 500.

Fig. 22 presents the external elevation of gate Narbonne wi with its great wooden defensive gallery over the entrance of the wooden crowning galleries placed on the tower and curtain at the right. The left tower is presented with its battlements and shutters in time of peace.[1] All masonry of that work i is entirely built of beautiful sandstone, greenish-gray and of good quality. The courses are chiseled along the beds and joints with a rough boss on the face; these beds are very well dressed and set on a bed of excellent mortar averaging 0.4 in. thick. The external and internal appearance of this gate is m most imposing and the internal rooms are admirably constructed with beautiful droved surfaces. To be complete, that construction only lacked the roofs, which were rebuilt recently under the direction of the commission of historical monuments.[2]

Note 1.p.341. This elevation is at a scale of 1 : 400.

Note 2.p.341. For more ample details, see Archives des monuments historiques, published under the auspices of the minister of the house of the emperor and fine arts.

Before leaving this edifice, so remarkable in all respects, it is necessary to take into account the working of the portcullises, still perfectly visible.

We shall take as example the second portcullis, that managed externally on the defensive gallery at the side next the city (Fig. 23). At A the portcullis is assumed as raised. At a are holes for fastening the two sides of the windlass at a' in section C. One still sees in place the two great eye-bars b in which was slipped a round iron bar intended to maintain the counterpoises c, when lowered. Further, two bars e, sketched at e' on the section, and entering holes arranged for that purpose, supported the raised portcullis. The fastenings of the two timbers f intended to support the pullies are intact.

When it was desired to lower the portcullis (see at B), by p pressing a little on the windlass so as to remove easily the pieces e and to slide the iron bar passing through the eye-r rods b; then it was dropped by loosening the two wheels of t the windlass. The portcullis having fallen, the two iron bars g were unhooked, and their eyes h were fixed on two iron pins still fixed in the wall. Thus it became impossible to raise the portcullis from the bottom. Two great iron hooks fixed at l supported a cross-beam of wood from which was suspended the shed roof sketched in the section (Fig. 20), and into which entered the timbers f. The counterpoise made the working easy for two men working on the windlass. If it was desired to raise the portcullis, the eyes h of the bars were slipped off their pins, these bars were hooked into the links of the chaain, and the men pressed on the windlass. That working was simple and rapid. The first portcullis was raised by the s same means. It was only necessary to have the counterpoises well balanced, so as to prevent the portcullis from buckling in being raised or in descending.

It does not appear that this work was ever attacked, and s since the epoch of its construction, history mentions no regular siege of the city of Carcassonne, although on several occasions the country may have been invaded, either by the troops of the Black Prince,,by the troops of Arragon or in the civil wars. Indeed with the means of attack at disposal in the middle ages, the city was an impregnable place, the gate Narbonne, the only one accessible to wagons, could have defied all attacks.

When one examines this gate in all its details, besides the beauty of the construction, the grandeur of the internal arrangements, one marvels at the care devoted by the architect to every part of the defense. Nothing superfluous, no form n not required by the needs; all is reasoned, studied and applied to the object. We know no edifice, that has a grander appearance than this broad flat facade looking toward the city. It is only a wall pierced by windows and slots, but is so well built, assumes such a grand air, that one cannot be weary in admiring it, and one asks whether the scrupulous observation of the architectural requirements is not one of the most powerful means of producing the effect.

The mode of attack of places must necessarily influence the arrangements given to fortified gates. When the besieging armies had not yet adopted regular and systematic methods to obtain possession of places, it is clear that their efforts must be applied to the gates. The first idea that came to the commander of the besieging army in times when no one possessed organized means of destruction, naturally was to enter t the besieged place by the gates, and of concentrating all his means of attack on those weak points; so on the contrary the besieged then brought to the defense of those gates a minute care, accumulating at those points all the obstacles and all the resources that their subtle minds could suggest. Yet already about the end of the 12 th century Philip August had learned how to make regular sieges, conducted with system and l like what the Romans would have done in such a case. During t the 13 th century, some well directed sieges indicate that t the art of attacking places was maintained at the point at w which Philip August had brought it;[1] but progress is scarcely sensible, while the art of defense is perfected in a remarkable manner. At the end of the 13 th century, the defense of places had acquired an evedent superiority over the attack, and when places are well equipped and well fortified, they can be reduced only by a close blockade. But from the beginning of the 14 th century, the engines being very perfect, armies acting with more system and harmony, we see appear in the art of fortification very important modifications. At first works in wood disappeared, that occupied so large a place in fortresses until this; and indeed by the aid of powerful machines, especially after the experience acquired in the East during the last crusades, they set fire to the wooden defensive galleries, however well covered they were with fresh hides or wet felts. Men renounced then first the movable wooden defensive galleries, established only in time of war, and replaced them by st stone galleries and machicolations.[1] Since improvements made in the attack were sufficiently notable, that men no longer attempted to force the gates; then made mine galleries, undermined the foundations of towers, supforted them with timbers, and setting fire to those supports, overthrew entire works. men possessed destructive machines sufficiently powerful to batter in breach projecting points, or to cast into a place

such a great quantity of burning or infecting materials, as to render it uninhabitable. There fore the defense of the gates assumed less importance. It no longer concerned more than protecting them from sudden attack, flanking them well, and giving them sufficient width tha a troop might easily return after a sortie, or take the offensive in case of a repulse s sustained by the besiegers.

Note 1.p.344. Art. Siege.

Note 2.p.344. Arts. Hourd, Machicoulis.

Those narrow and low gates of the 12 th and 13 th centuries, so lavishly equipped with obstacles, assumed breadth; the little tricks accumulated under their passages disappeared, but on the other hand the flankings and advanced works are better and more broadly conceived; the external defenses sometimes b became what are termed forts, i.e., actual fortresses placed across a passage.

During the last years of the 13 th century, Philip the Fair caused the erection of an important citadel opposite Avignon,[1] opening by a single gate at the accessible side, i.e., at the south and opposite the little city of Villeneuve-les-Avignon. That gate is flanked by two great towers crowned by machicolations. Its opening at the narrowest part is 13.3 ft., a width unusual for the gates of the 12 th and 13 th centuries. We g give the plan of the ground story (Fig. 24). Between two pointed arches falls a first portcullis A, behind which at B swings folding doors. At C is a machicolation before the second portcullis D, behind which is hung the second folding doors. The crowning machicolations defended the first portcullis. One penetrates into the two towers by the doors E, closed by doors in grooves, worked from the rooms of the second story. The two portcullises A and D are worked from a vaulted room situated directly over the passage; two screw stairs ascend f from the ground story to the rooms of the second and to the upper platform, which is paved wit stone slabs above the vaults. On this platform over the room for managing the portcullises rises a little squar structure with tunnel vault, the stone platform of which is reached by a miller's ladder passing through a trap arranged at the centre of the vault. In t this construction all carpentry work was excluded, so as to r remove that defense from the chance of fire. The construction

is treated with extreme care; built of excellent stone from Villeneuve in regular courses 10.6 ins. high, it has suffered no change. The vaults are built wit the greatest perfection, thick, well filled on the haunches with excellent masonry. T The two screw stairs open into the rooms, dungeons and privies, placed in the projections connecting these towers with t the adjacent curtains. At the side of the left projection is seen one of those discharges from the priv es falling outside. A drawbridge of a later epoch had been arranged before the fi first portcullis. The vicinity of this gate was originally defended by an advanced work, a sort of barbican represented in Fig. 25, giving the external elevation of the gate of Villeneuve-les-Avignon. This elevation shows at the centre a square structure that surmounts the platform and the crenelated tops of the screw stairs, that are on the right and left and serve as watch-turrets and complete the defense of the two projections. The top structure by its dominant position commanded t the vicinity, and could receive one or two machines with a long reach. Machines, stone-throwers and mangonels could also be placed on the stone platforms of the towers. By suppressing carpentry roofs fires were avoided, and by installing casting machines the approaches were made more difficult; for those engines then fulfilled the purposes of our rampart guns. All leads to the belief that the two projections, that unite the towers with the curtains, were chiefly intended to receive formidable machines, which that position struck the assailants, who desired to approach the gate by the sides of the two towers. Indeed, thus were attacked the gates during sieges, after the 12 th century. The besiegers avoided presenting themselves before these gates, always equipped in front. They formed their attack on an oblique line, covering themselves by mantlets, breastworks and galleries of wood, against the projectiles from the curtains; leaving the barbicans occupied by the defenders to close a tacks, they took them laterally and thus reached the base of the towers of the gates at the point most difficult to defend.[1] It was in foresight of this kind of attack that the military constructors made those projecting breaks or spurs reinforcing their gate towers at the attackable point, and compelling the assailants to keep away from the tangent; but from the instant that the tops of towers

could be equipped with casting machines of long reach, this means of close defense became superfluous.

Note 1.p.348. See Art. Pont, where are presented these works concerning the bridge of S. Benezet of Avignon.

Note 1.p.348. See Art. Siege.

A section made on the axis of the passage of the gate of Villeneuve-les-Avignon (Fig. 26), will complete the knowledge of this beautiful work of truly imposing appearance. This section B indicates the groove of the first portcullis at M, the first door at f, the groove of the second portcullis at D and the second door at e. One will note, that according to accepted u usage as far as permitted by the form of the ground, the ground of the passage rises from the exterior to the interior. Above the passage is seen the room for working the two portcullises, and over that room is the upper structure, surmounted by a machine with long reach. Before the second portcullis D opens a machicolation. Fig. A gives the cross section of the passage made on a b looking toward the entrance. At E are still fixed the tree iron rings 9.8 ins. diameter., which served to suspend the pulleys required for working the chains of the first portcullis.

But the site of Villeneuve-les-Avignon is situated on a hill of abrupt rocks, and its gate opens opposite a buttress descending to the plain. In such a location, there is no need of ditches nor of very strong advanced works, for the site of t the place already offers an obstacle difficult to conquer. T The passage of men going and coming is limited to sorties an d retreats of the garrison. The gate just presented above is t then rather the entrance of a castle than that of a populous city, whose gates must be left open for the entire day. The gates of the city of Avignon in the 14 th century were indeed works arranged for a fortified city, but containing a numerous and active population.

The ramparts of Avignon were built from 1348 to 1364. They were pierced by several gates, either on the bank of the Rhone or on the side next the plain, among them we shall choose gate S. Lazare, one of those best preserved and for which we possess complete documents.

Note 2.p.348. To the courtesy of M. Achard, the learned archivist of the prefecture of Vaucluse, we owe the greater part

of the information tha has aided us in restoring this gate in its primitive condition.

Gate S. Lazare of Avignon was destroyed, or at least very greatly damaged by a formidable flood of the Durance in 1358. It was rebuilt under Urban V about 1364, with the entire part of the ramparts extending from that gate to the rock des Doms, by one of the architects of the palace of the Popes, Pierre Obreri, if the tradition is credited.

Here (Fig. 27) is the general plan of this gate with the l li tle fort covering it. There remain of these structures today only the gate A and the substructures of a part of the f fort, but complete drawings of the advanced works have been preserved to us.[1]

Note 1.p.349. The drawings belong to M. Achard, who was quite willing to allow us to copy them.

Those arriving presented themselves by a road B at the side of the fort; they must pass the first drawbridge C, cross the esplanade of the fort diagonally and cause the barrier D to be opened; to pass over a second drawbridge E, enter an advanced work F closed by a drawbridge and defended by two turrets with machicolations; present themselves before the gate protected by a line of upper machicolations, by a portcullis and by a second machicolation pierced before the doors. The fort was entirely surrounded by a ditch G filled with water, just as the great ditch H protected the ramparts. Those ditches w were fed by the natural streams that surround the city and t the entire extent of the walls not facing the Rhone.

Three low towers flank the fort. One ascends to the upper stories of these towers and to the battlements of the curtains by the stairs K. A cavalier view (Fig. 28), taken from the po-point X of our plan, will show the entirety of this gate with its front defenses.

The three towers of the fort were vaulted and covered by a stone platforms at the height of the battlements.

It is easy to see tha the fort was open at the rear and w was commanded by the front of the gate, jus as this front w work was dominated by the square tower crowning the last entrance. This work was then already constructed according to t that rule of for ification, that what defends must be defended.

The longitudinal section made on the gate A of the plan and

the plan and the front work (Fig. 29) shows the details of t this defense. At B is the lowered drawbridge, at C is the door that leads by stairs in the thickness of the wall to the battlements of the front work, at D is the groove of the portcullis; at G the machicolation that protects the doors H, at I the passage covered by a floor; the portcullis is worked from the landing K, to which one ascends by a stairs L placed on a projection from the lower wall; for it is necessary to note that the upper wall M is much thinner than the wall of the ground story. That stairs L further serves to relieve the stairs marked I on the general plan, and that ended in return beside the round arch supporting the windlass of the portcullis. By taking a wooden stairs from the landing K, one ascended to the upper story under the roof, and entered the defensive gallery of the battlements by the door P arranged in a stone lobby placed at the angle of the battlements. Each door of the ramparts of Avignon was furnished with a bell, so as to warn the defenders or the inhabitants in case of attack or surprise. If we make a transverse section on the line a b of Fig. 29 of the general plan, looking toward the entrance of the front work, we obtain the sketch S. The drawbridge being raised, its floor closes the opening T, and its arms passing through the two slots V, as marked at V′ on the longitudinal section, nowise interfere with the defense. The middle crenelle and its two slots remained free, and the two lateral turrets flanked the gate. From the room in the second story of the tower, one passed to the defensive gallery of the curtains p by the doors N. On the side next the city a simple half timber wall pierced by openings enclosed the upper stories of the t tower.

Fig. 30 gives at A the elevation of the work with the front work, and at B the elevation of the tower, making a section through the advanced work.

The gate S. Lazare of Avignon is already remarkable by the simplicity of construction. Here one no longer sees that accumulation of obstacles, whose complex arrangement must frequently embarras the defenders. It is true that the gates of Avignon are not very strong, but they indeed have the character suitable for the walls of a great city. Gate S. Lazare, with its rampart or external barbican, efficiently protected a body or troops desiring to attempt a sortie, or obliged to fight

in retreat. One could easily mass 500 men on the esplanade of the rampart, protect their sortie by means of flankings furnished by towers; and if repulsed, they found in that enclosure a safe refuge, without disorder and a precipitate retreat being able to compromise the principal defense, that of the gate belonging to the curtains. Finally if the rampart had f fallen into the hands of the besieger, the defenses were entirely open at the side next the city, and by means of the crenelated front work, the besieged could compel the assailant to shut himself within the three round towers and to leave t the esplanades and curtains free, which facilitated an offensive return.

The arrangement of gates opened through the simple square tower without flankings belongs more particularly to Provence. It existed at Orange and Marseilles, and there still exist at Carpentras, and Aigues-Morts gates of the end of the 13 th a and the beginning of the 14 th centuries, opened through square towers without turrets or little flanking towers; while the works of this kind that belong to the royal domain, with very rare exceptions, are furnished with round towers or pronounced flankings.

The little city of Villeneuve-sur-Yonne still possesses a very pret y gate of the beginning of the 14 th century, that merits mention among many others by the arrangements of its flankings.

That gate was modified in the 16 th century in its upper part by the new roofs, yet allows all its primitive arrangemets to be seen. Fig. 31 gives its plan.

At A was a drawbridge flanked by two angular turrets forming spurs and solid in their lower parts. At B was a wide machicolation, now filled, tha protected the first portcullis C. W Wooden folding doors closed the passage at E. At G is the second portcullis preceded by a second machicolation, and at I is a second pair of doors. One ascended to the upper stories of the gate and to the curtains by the two external stairs H. At P were obliquely presented on the exterior two great machicolations, that swept the drawbridge, and through which passed the chains serving to raise the bridge. The sketch V gives t the plan of tre upper part of the gate. One sees the two flanking crenelated turrets, that connected the bridge and the o

outside; at N are the two oblique machicolations through which passed the chains O of the drawbridge; at S is the windlass s serving to work the chains; at T is the upper defense dominating the entire work.

Fig. 32 presents the external elevation of the gate of Villeneuve-sur-Yonne. This elevation illustrates the twofold function of the oblique machicolations. That entire structure is built of pebbles and grit with stone quoins at the angles. P Perhaps to the goodness of the construction and to the small value of the materials we owe its preservation.

A longitudinal section made through the front part of the gate (Fig. 33) shows the working of the drawbridge and its m mechanism. Counterpoises are suspended at the ends of the floor beams and facilitate its movements when the windlass T is turned. The first portcullis being lowered, the machicolation that protected it was open to the defenders. In this example, as in all those previously given, the defense only acted at t the top of the gate, and by the arrangement of the turrets o and of the great oblique machicolations, the ditch and the v vicinity could be covered with projectiles.

One understands that such a work, however small in extent it may be, must be very strong. Besides the curtains had a s strong projection, and were reinforced on the front opposite the river by a great cylindrical keep, that still exists. The entire enclosure of this little city, so pleasingly located on the banks of the Yonne, was pierced by only four similar gates, two on the fronts upstream and downstream, one near t the keep and the other opposite the bridge thrown across the Yonne. Six cylindrical towers placed at the angles formed to the curtains completed the defenses. As for the keep, it is separated from the curtain by a ditch, that bends in a semicircle to give room for it. It is connected to the defensive gallery only by a drawbridge, and was pierced near the exterior by a postern at the level of the counterscarp of the ditch.

In 1374 the keng Charles V caused the rebuilding of the walls of Paris on the left bank removing very much the walls beyond the limits fixed under Philip August. This new wall nearly followed the existing line of the internal boulevards, and was pierced by six gates, that were in starting upstream, gates S. Antoine, Temple, S. Martin, S. Denis, Montmartre and S. Honore.

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most of those gates were built on a square or oblong plan with flanking turrets. One of the most important, and of which engravings remain to us, was gate S. Denis.[1] "Our kings," says Du Breuel,[2] "when making their first entries into Paris, enter by this gate, that is decorated by a rich advanced portal, where are seen various admirable statues and figures, made expressly, with some verses and sentences in explanation of them. Al Also by this gate the bodies of deceased kings go out to be borne in funereal pomp to S. Denis in France." The gate S. D denis was built to project strongly from the curtains, and formed an actual fort, in which could be lodged a body of soldiers. In 1413 the duke of Burgundy presented himself before P Paris at S. Denis with the intention of speaking to the king, he said; but as states the Journal d'un bourgeois be Paris sous the regne de Charles VI,[1] "The gates were closed to him, and were walled up as formerly, with this grea abundance of men-at-arms to guard them day and night."

Note 1.p.357. See the topestry at the city hall and the great birdseye plo. of Merion, and the engraving of Israel Sylvestre.

Note 2.p.357. Book III. p. 1082, edit. of 1612.

Note 1.p.359. Collection Michaud. Vol. II. p. 641.

Indeed most of those gates were walled up several times during the wars of the Armagnacs and Burgundians. Thus even at t that epoch, the beginning of the 15 th century, one could not trust enough to the ordinary closeness of the gates of cities, that it was felt necessary to wall them up in case of siege. It must be stated that this means was particularly adopted, w when was feared some treason on the part of the inhabitants. Then the gates became bastiles and forts, permitting the placing of numerous posts on the external ramparts.

The gates built at Paris under Charles V lent themselves p perfectly to that service, as one can recognize by examining the cavalier view, that we give of gate S. Denis (Fig. 34). The great projection of this work from the curtains gave a good flanking for the time, and permitted the establishment of a false work with small ditch inside between those curtains, and the wide ditch fed by the river, now in part lost beneath the modern structures of the city.[2]

Note 2.p.359. The engraving of Israel Sylvestre shows the

place of the false work with its ditch behind it.

This gate was restored or rathe: modified in the 16 th ce tury. The upper battlements were replaced by parapets desti ed to receive artillery. It was demolished under Louis XIV give place to the triumphal arch that still exists, and whi was connected to a system of curtains and bastions not wall

Our cavalier view shows the little internal court, that w necessarily surrounded by slots in the second story, so as cover with projectiles the assailants, that could force the drawbridge. The second story thus contained rooms at the fo sides of the court, sufficient to house a very numerous gar ison. Two stairs arranged in the rear turrets served these rooms and the upper crenelated story covered by a terrace. obably the lateral arches were pierced by wide machicolatio and in their rear walls opening on the court opened slots e filading the space between the false work and the curtains.

Besides, barriers and palisades defended the approaches o the bridge,[3] itself protected by crenelation and two turret

Note 3. Art. Barriere.

Like all works erected at Paris during the middle ages, t ese gates were well executed in masonry faced with cut ston and possessed that grand monumental character, that indicat the great city.

That wall, pierced by beautiful gates, rested at the east on the Bastile, built at the same time, but finished only a the beginning of the reign of Charles VI.[1]

Note 1.p.360. Art. Bastille.

About the beginning of the 15 th century, the art of fort ication of places tended to be modified. Du Guesclin had ta by strong force such a great number of places without resor ing to the regular method of siege, that it was necessary t enceforth to seek to keep off assailants by extended advanc works, especially before the gates; works forming large ram arts sometimes connected together by pits or simple palisad wen recognized at the moment when artillery began to play a part in sieges, that it was important to cover the approach and gates by terraces or thick walls of small height, comma ded by curtains and towers.

There exist at Nevers a beautiful gate of the end of the th or the first years of the 15 th centuries, that possesse

very apparent remains of the great advanced work that protected it. The gate of Croux (for thus it is named) consists of the rampart H with a thick wall B on the covered way from which one ascended by a stairs C made in the thickness of one wall of the guard wall D, which flanked the external gate E, protected by a ditch F and closed by a drawbridge. This first entrance was enfiladed by a curtain D". A body of troops could be massed in that area A, which had nearly the form of a bastion, and which was placed in direct communication with t the road G only by a postern H. If the assailants succeeded in forcing the first gate E, they found themselves taken in flank by the defenders lodged in A. Perhaps there formerly e existed a flying bridge placing the rampart A in communication with the ramparts of the city. The space I was only a hill, a and at K was excavated the ditch surrounding the walls of the place. The gate L of small extent flanked the curtains M. It was closed by drawbridges and doors at P. Besides th entrance intended for wagons, this defence possesses a lateral postern, with separate drawbridge, allording to a custom generally adopted after the 14 th century. The passage of tha corridor was bent, although permitting the working of the arms of the little drawbridge, and was placed in communication wi the city by the gate R, and with the great ca riage gate by the gate S. Barriers were then placed at T, so that if one desired to send footmen or a guard into the city, only the drawbridge of the postern was lowered, and these men could be recognized by the guard posted at L before being able to enter the city. The passage of this postern by its irregular form made the passage of the men on foot more difficult, and caused that all the small gates being open, the man placed on the drawbridge could not see what passed beyond the defense in the interior of the city. Men came to the second story of the gate by the stairs O, and from that first story to the battlements and upper machicolations by the internal stairs of wood.

Fig. 36 gives the external elevation of the principal work. One sees in that elevation the two slots of the great drawbridge and the single one of the postern bridge. The fronts of the towe on the three outer sides are defended by crenelated machicolations, and the angles by two turrets, whose floors a are raised a little above that of the machicolation. The lat-

latter are composed only of stone corbels with a thin crenelated wall set on their ends. Planks are laid on the corbels and permit the defenders to use the battlements and slots, a and to drop stones between the corbels on the assailants.

We shall indicate the arrangement of the mechanism of these drawbridges of the 14 th and 15 th centuries. Let (Fig. 37) this be a gate with width and height sufficient to allow the passage of horsemen and wagons, i.e., according to the mode adopted in the 14 th century, about 11.5 ft. high and wide. This gate is presented at A as seen externally, at B as internally, according to a transverse section made across the passage. At C is one of the slots of the drawbridge as shown externally, and at C is masked by the internal wall of the room in the second story. The plan D made at the level a b explains the working of the drawbridge. It is raised by pulling on the chains E; then the rear end F of the beam I is moved by the weight and falls to F′, after describing a circular arc, and the timbers I come to rest at I′. The floor K describes a circular arc on its pivots, rises to K′ and covers the entrance; the timbers behind, the chains hang in the angle, and thus compel the floor to rest on the jambs and arch of the gate. It is well understood to be necessary, that the length of the chains is to be calculated to obtain this result, and to leave to the timbers an inclination, that facilitates the first effort in raising. The floor is composed of the frame of strong beams with X-braces, on which are nailed the planks. Another X-brace and cross beams solidly connect the two timbers inside.

At L we show one of the pivots of the timbers, and at M is the iron socket in the stone intended to receive those pivots.

In our days the working of the drawbridges is made easier and more certain by means of windlasses, pullies with chains after Vaucanson, but the principal has remained the same.

Drawbridges of posterns are raised by means of a single timber, at the end of which was suspended an iron fork receiving the two chains. But we shall have occasion to speak of these drawbridges when specially occupying ourselves with posterns. (Art. Poterne).[1]

Note 1.p.385. Also see in Art. Pont different systems of drawbridges.

The use of artillery against strong places compelled the m modification of some of the defensive arrangements of gates after the 15 th century; but then the siege artillery was transported with difficulty,[2] and most frequently besieging armies had only pieces of small calibre; or indeed if they succeeded in placing in battery mortars of very large calibre, this kind of piece only threw stone balls like shells, just as the machines with counterpoises. If those great projectiles in passing over the walls of a besieged place could cause damage, they did not breach and rebounded on the surfaces of the towers and walls, inefficient if the walls were thick and well built. Military engineers thus but moderately occupied themselves with modifying the old defensive system, as for t the general arrangements, and had made few changes except in the battlements, so as to post musketeers there. We have an e example of these alterations that one of the front gates of the little city of Flavigny. This gate (Fig. 38) is still flanked by two cylindrical towers pierced by slots at their bases, at mid-height and at the top. Those openings are made for very small guns and are round. The gate itself as well as its postern in surmounted by a machicolation with a parapet also pierced by round holes. This work precedes a gate of the 14 th century, now partly demolished, and which was closed by a portcullis anf folding doors.

Note 2.p.38 . Arts. Architecture Militaire; Engin.

Fig. 39 gives at A the internal elevation of the gate presented externally in perspective in Fig. 38. One will note that each corbel of the machicolation supports a stone wall that strengthens the parapet, That arrangement is further explained by the section B. It must be added that this gate opens at t the top of a precipice and that the road leading to it has a very steep slope. In such a position, there was no need of d ditches nor consequently of a drawbridge; the assailants presenting themselves before that gate had a precipice at their backs. However simple it is, this gate is a pretty example of the military structures of the epoch of transmission, at the moment when the architects were preoccupied with the use of artillery.

Olivier de Clisson, brother in arms of du Guesclin, who made such disastrous war against the English, was a general of rare merit, who fortified a very great number of castles of Poitou,

and on the frontiers of Guienne. He adopted for the defense of gates that system that seems to belong to him. He erected a round tower on a bridge, and pierced it by a passage closed by portcullises and folding doors. On the bridge of Saintes exists a gate of this kind,[1] and still to be seen in the provinces of the West. One of the gates of the walls of the castle of Montargis presents that arrangement, and the central opening of that tower is uncovered anf allowed from the top of the tower the crushing of the assailants, who had penetrated therein between the two gates pierced in the opposite walls of the cylinder.[2] The round towers serving as gates, that appear to belong to the initiative of the constable Olivier de Clisson, are generally very high, i. e., giving a considerable command over the vicinity. They are isolated and are not connected to the curtains of the enclosures. They are little forts across a bridge, so that the besieged shut within these posts, having only very uncertain means of retreat, were more disposed to defend themselves to extremity. It very frequently occurred indeed, that becoming the object of a very violent and continued attack, and being gradually abandoned by the defenders, who found by way of the adjacent curtains, that t they were a means of easily abandoning the system, on the pretext of extendind the field of the defense. Shut up in an isolated tower serving as a gate, the garrison had no resource except to fight to the last extremity. The arrangement that seems to have been systematically adopted by the constable O Olivier de Clisson is further conformed to the energetic character and even ferocity of that warrior.[1] Thus many military works of the middle ages assume an individual appearance, and it is very difficult by some examples to give a survey of all resources found by the constructors. Thus we only pretend here to present some of the arrangements most generally adopted or most remarkable. Besides, it is not doubtful, that the military structures of the middle ages, the personal ideas of the lords causing their erection had a considerable special influence on the arrangements adopted, and tha these lords in many cases themselves furnished the plans executed, such is the gr great variety of these plans. It is well to remark also, that if during the middle ages the constructions of churches and of monasteries are frequently neglected; that it is evident in

those structures, that supervision was lacking, but one cannot make the same reproach for military works. These, although v very simple, or erected by the aid of means sometimes limited, are always built with extreme care, indicating the most assiduous supervision, the direction of the master. Due to that g good execution, that we have retained in France such a great number of those works, in spite of the destructions first undertaken by the monarchy after the 16 th century, during the revolution of the last (18 th) century, and finally by the c communes since that epoch.

Note 1.p.367. Art. Pont, Fig. 4.

Note 2.p.367. See Des plus excellens bastimens de France, by Du cerceau.

Note 1.p.368. Olivier de Clisson was named by his contemporaries the Butcher.

Before passing to the examination of posterns, we must say some words on the gates of barbicans, i.e., belonging to great advanced works, gates that present particular arrangements.

It was only in the 13 th century that men began building barbicans of masonry. Until then these advanced works, intended to facilitate the sorties of numerous troops or to allow retreats, were generally built of wood, and consisted only of terraces with ditches and palisades. But the besiegers by setting fire to these works made their defense impossible; they they adopted the system of constructing barbicans of masonry, outside important places, and strengthening them by towers if necessary. Yet men always sought to open these defenses at the side opposite the ramparts forming the body of that place, so as to prevent the besiegers lodged there from maintaining themselves there. The galleries of the barbicans are conceived according to these principles, and the defenses composing them are open at the gorge (rear).

About the end of his reign, the king Louis IX caused the restoration of the external walls and the repair of the castle of the city of Carcassonne. At the side of the city, he caused the construction of a barbican of semicircular plan, which defended the approach to the gate of the castle, a gate already given in Figs. 3, 4, 5, 6.[1] The barbican of the castle of Carcassonne in form of a half moon, opens on the streets of the city by a gate of simple and well understood construction; t

and that gate not not projecting from the face of the circular wall forming the barbican, is opened entirely in the interior, so that th defenders of the entrance of the castle can compl - etely see those of the gate of the barbican, and even give t them orders. If the besiegers obtained possession of this fi- rst entrance, it was easy to cover them with projectiles.

Note 1.p.369. For the plan of this barbican, see Fig. 11 at R. (Art. Architecture Militaire).

Here, Fig. 40 at A, is the plan of this gate at the level of the ground, the exterior of the barbican being at B. A machicolation C defends the folding doors closing at D. At E is the entrance to the stairs in the open, that ascend to the up- perstory; at F is a closet intended to receive the torches and other equipment necessary for the service. The plan G is taken at the upper crenelated story, that is reached by the stairs I and the steps J. The defensive galleries K of the circular c curtain are placed 3.3 ft. below the floor L. One sees at M t the opening of the machicolation that protects the folding d doors. Lateral battlements enfilade the defensive galleries, and are isolated from the defensive story of the work by two doors O. That upper story, like the entrance to the ground s story, is commanded by the defense of the gate of the castle.

Fig. 41. presents the external elevation of this gate, and Fig. 42 is its section made on its axis. The appearance of the work from the interior of the barbican is reproduced in the perspective view, Fig. 43. It is easy to recognize in examining this last Fig., that the upper defenses, like the entrance, are open at the side next the castle, and that it was therefore difficult for a besieger to maintain himself there opposite to the great defense, that protected the gate that we have given. Figs. 3, 4, 5.

But quite generally the gates of barbicans opened laterally in reentrant angles, so as to be well covered by projections, and then they were only openings not defended by themselves.[1] These barbicans about the beginning of the 14 th century assumed a greater importance from the point of view of the defense; they were furnished with towers, as we have shown above, when occupying ourselves with gate S. Lazare of Avignon; they took the name of forts, bastiles, ramparts, and their gates, while commanded by internal works, were often flanked by little towers

or turrets. Such defended the gate of two mills at Rochelle, situated behind the tower of the lighthouse;[2] those of S. Jean d'Angely; of S. Jacques at Paris; of Orleans, etc.

Note 1.p.371.Art. Barbacane, Figs. 2, 3.

Note 2.p.371.See Topographie de la Gaule, Merian.

Among those gates preceded by forts, one of the most remarkable was that of the castle of Marcoussis, that dated from the end of the 14 th century, and whose destruction is so regretted. There the defensive system was complete. The front gate opened at the side of a square fort defended by two towers. From the fort the communication of the entrance of the f fortress was by a fixed wooden bridge, then over a wide ditch filled with water, and a drawbridge. This entrance was flanked by two grea towers, then rose beyond the corner tower, s surmounted by a very high turret, that permitted seeing all that passed in the fort and outside. The gate of the castle and its defensive works absolutely commanded the fort at a very small distance.[1]

Note 1.p.373. See Topographie de la Gaule. Merian.

PORTES DE DONJONS. POTERNES. Doors of Keeps. Posterns.

The keeps possessed doors defended in quite a particular f fashion. These doors were often raised above the level of the external soil so as to place them under protection from a direct attack; wooden ladders were then arranged by the garrison so as to be able to enter these forts or to leave them. But i is understood that this arrangement presented s rious inconveniences. If the defenders of the castle or city were compelled to take refuge hastily in the keep, this means of access was insufficient, and it occurred (as tha presented itself during the last phase of the siege of castle Gaillard by Philip August),[2] that the defenders taken at a disadvantage, had no time to enter the keep. Then they sought to render the doors of keeps as difficult as possible to force, while leaving to the besieged the means of taking refuge in a silid mass in t the last defense, if they were pressed too closely. Many keeps had two posterns, one visible and the other subterranean, and communicating with the exterior, so that if a garrison thought it could no longer hold out in the place, either from the vigor of the attack or lack of provisions, it could escape and

leave to the assailants only an empty fortress. The great great Norman keeps on square plans were generally so arranged.[3] But still, once that the garrison was shut within their walls, it became very difficult to leave before a prudent enemy, either to escape or to attempt offensive sorties, for the subterranean posterns were not so secret, that the besieger could have no knowledge of them, and the doors elevated above the ground outside were difficult to pass in presence of the besieger. T Those problems seem to have occupied the constructor of the admirable keep of Coucy. That keep possesses a door pierced at the level of the counterscarp of the ditch excavated between the tower and its curtain, and a little postern elevated to the level of the defensive gallery of that curtain, which by a stairs is put in communication with a postern opening to the exterior of the place.[4] The door of the keep of Coucy is pierced in the ground story, and is arranged with minute care; it allows the garrison either to cross rapidly that ditch, to descend to the stone pavement forming its bottmo, and to reach the external postern, or to protect a body of soldiers very closely pressed by the assailants; further, contrary to the o customs of the time, this doorway is very richly decorated by sculptures in a beautiful style.

Note 2.p.373. Art. Chateau.

Note 3.p.372. Art. Donjon.

Note 4.p.373. Art. Chateau.

Fig. 44 gives at A the plan of that doorway, and at B is i its longitudinal section. It is closed (see the section) by means of a drawbridge, a portcullis, folding doors with bars sliding into the thickness of the masonry,[1] and a second pair of folding doors, also barred. The drawbridge was raised by means of the windlass C placed in a room reserved over the p passage, a room reached by the only stairs of the keep.[2] This windlass was so arranged, that one could at the same time lower the bridge and raise the portcullis, the chains of the bridge and of the portcullises coiling in opposite directions on its axle. But the arrangement of the floor of the bridge proves the lare applied by the constructors to that point of the defense. The floor of the bridge pooves the care applied by the constructors to that point of defense. The floor of the bridge swings on an axis, its rear end describing the circular arc b.

When it came to the horizontal plane, it was held fixed by a movable strut o′, that dropped into a recess made in the projecting course e; then its floor was on a level with a fixed wooden floor G that crossed the ditch, a floor whose two side timbers H rested on two corbels I. That fixed floor could itself be easily dropped, if the besieged wished to shut themselves absolutely within the keep. Indeed inclined struts K, whose feet entered three recesses L were held at top by wooden blocks M held by keys m. By dropping these keys by a device easily operated above the bridge the struts dropped; the side timbers were then easily operated above the removed, and all communication with the exterior was apparently interrupted. Yet if we examine the floor of the drawbridge drawn separately at N, we note that a part O of that floor is arranged like a ladder. That portion was made movable and swung in the axis O. By removing an iron pin shown on our Fig., the movable portion dropped and came to rest at n (see section). From that m movable portion of the floor was suspended the end of a ladder P, which hung at P′ when the floor was dropped; hence the besieged could descend into the ditch by that ladder, and these were protected by the little work R of masonry pierced by slots. From that recess they descended by some steps to the stone floor forming the bottom of the ditch, being able to go towards the postern of the curtain that communicates with the exterior of the place. The movable floor of the bridge being raised, the portion O serving as a ladder being lowered, the garrison thus found means for a sortie without any need for lowering the bridge; it then sufficed to open the inner folding doors and to raise the portcullis; which could be done without lowering the bridge by unhocking the chains from the a axle of the wendlass. The movable portion O of the bridge was raised by means of the chain S. The plan A indicates the carpentry of the drawbridge and that of the fixed floor, its side timbers being drawn at d. One sees that at one side at f there remains quite a wide space. That space is found reserved at the side where the besieger could most easily present himself at the bottom of the ditch. This was a machicolation, for with those timbers and the supporteng bars g indicated on the section, in case of attack one could establish mantlets pierced by slots to sweep the ditch. On that side there likewise exists

below the corbels h (see plan) a stone probection that masks the underside of the bridge and the defenders descending by the ladders. At T we have drawn the transverse section of the passage made through the hoisting room and looking toward the entrance.

Note 1.p.374. Art. Barre.

Note 2.p.374. Art Donjon, Fig. 35.

Fig. 45 completes that description; it gives the elevation of the doorway of the keep of Coucy, with all existing traces of the mechanism of the drawbridge. One sees at a the treee recesses receiving the feet of the struts; at b the little defended terrace descending to the bottom of the ditch; at c is the gain receiving the strut of the drawbridge to keep it horizontal; at d is the projection forming a guard; at e are the corbels receiving the stringers of the fixed bridge; at f the recesses for the supporting bars; at g are the pulleys for directing the chains of the drawbridge. The stone pavement of the bottmo of the ditch is at h. At l is traced the section of the drawbridge with its movable part at i serving as a ladder.

The tympanum of the doorway is decorated by a relief representing the lord of Coucy fighting a lion, according to the legend. Personages in civil costume decorate the first arch, l leafy crockets the second. One notes that of the two supporting bars f', that the bar f' alone is placed vertically over the isolated stringer of the floor and leave a machicolation open; it is because this supporting bar being placed at the attackable side, is found combined with the stringer by a wooden man let pierced by slots, as we have stated. For the same reason on this side the projection d being intended to prevent arrows that might be shot obliquely by the besiegers, f from striking after rebounding, the defenders descending the ladder to the bottom of the ditch.

All is thus foreseen with rare subtlety in this work; but it must be recognized that the keep of Coucy is an incomparable work, conceived and executed by men that seem to belong to a superior race. In this fortress the most delicate art a and the most beautiful sculpture find themselves united to t the foreseeing strength of the warrior, as if to prove to us that the expression of the useful loses nothing in taking into account the beauty of form, and that a military work is not

less strong, because the engineer that erected it was an artist and a man of taste. Beside that truly masterly work most doorways and keeps are but exits of little importance. Their closures consist of portcullises or drawbridges, or of simple folding doors protected by a machicolation. Still we must mention the narrow doorways furnished with a drawbridge with a single timber, and that are seen in the military works of th e 14 th and 15 th centuries.

Here (Fig. 46) is the most general arrangement of these doorways.

They consist of an opening 3.3 ft. in width at most and 6.6 to 8.2 ft. in height surmounted by a recess destined to receive the single timber supporting a movable footbridge. At A is presented the external elevation of the doorway, at B its section, at C its plan. The single timber D suspending the footbridge is pivoted on the axle a, and being raised fits in the slot E. Then the floor G enters the recess g and closes the e entrance. This floor is suspended by a chain to which is attached an iron arc K, which receives two other chains L, that support the end of the footbridge M. The timber D being raised, the iron arc lodges in l, and the chains being inclined backward force the floor to enter the recess; almost always a portcullis closes the rear end of the passage of the doorway, as our Fig. indicates. We have given some examples of gates of cities, that possess beside the carriage gate one of these posterns with drawbridges, moved by a single arm (Figs. 34,35). When it is necessary to cause a patrol to go out or r return or a single person at night, the footbridge of the postern is lowered; thus is avoided the working of the great drawbridge, and one does not have to fear surprises. Sometimes for entrances of keeps, the footbridge consists of a ladder, that is lowered to the ground, and then the chain is moved by a wi windlass and an arm.

But there is a series of posterns of strong places that present a very special arrangement. When these places contain a numerous garrison, it is necessary to be able to supply them rapidly, no only with projectiles, arms and machines, but a also with provisions. Now if one considers that most of these places are located on precipices, that access to them was difficult for anyone; the entrances were narrow and few; that

in time of war the abundance of wagons and men outside became a danger; tha the guards of the gates must then carefully s survey those arriving; that sometimes men obtained possession of cities and castles by concealing armed men in wagons and obstructing the passages of the gates, one will understand why the supplying was done from the outside without compelling the garrison to drop the drawbridge and raise the portoullises. Then those supplies were brought to the base of a curtain at a postern elevated very high above the external soil, in a particular place, well masked and flanked; they were hoisted into the fortress by means of an inclined plane, placed at that postern.. There was at S. Michel-en-Mer a long incline so arranged at one side of the upper fortress opposite a sea gate. This plane of masonry ended at a postery furnished with a windlass, and thus the provisions and all burdens were introduced into the place, without its being necessary to open the principal gate. This plane was for that purpose and the supplies of the fortress were brought only by that way. The castle of Pierrefonds also possessed its postern for victualling. We have indicated its position in the plane of that castle. (Arts. Chateau, Fig. 24; Donjon, Figs. 41, 44). The castle of Pierrefonds could easily contain a garrison of 1200 men; it w was then necessary to find means of supplying a considerable quantity of articles of all sorts, arms and projectiles, in a brief space of time, if as frequently occurred during the middle ages, one suddenly found himself under the necessity of placing himself on his defense. Were it necessary to introduce wagons, beasts of burden and men from the exterior into t the court of the castle to complete the supplying, the embarrassment would have been extreme, the place would have been opened to everyone, and it would have been impossible during that time to prepare the defense, and to adopt measures of o order necessary in such a case. The court being crowded on all those wagons, packages, animals and men, would have only presented confusion; impossible then to admit and to send out men at-arms, to arrange the posts, and particularly to conceal t the means of defense. Thus one conceives why the architect of the castle combined a postern allowing the introduction of t those supplies, without allowing the men inside to be obstructed or relaxed in their arrangements, and without its being

necessary to admit a wagon, nor a man strange to the garrison into the place. Not only is the supply postern of the castle of Pierrefonds elevated 32.8 ft. above the external road around the firtress, but it opens into a special court separated from the principal court of the castle by a gate closed by a portcullis, by folding doors, and protected by machicolations. (Arts. Chateau, Fig. 24; Donjon, Fig. 41). This supply postern is pierced through a high curtain 9.8 ft. thick. Its threshold, as we have just stated, is placed 32.8 ft. above the level of the external soil. An inclined plane of masonry and carpentry rose from the road to a height 6.6 ft. below the sill and 13.1 ft. from the curtain. Thus there remained between the top of the inclined plane and the postern a space crossed by a drawbridge when lowered. Fig. 47 will aid us to explain this work. At A is sketched the plan of the postern, two battlements a are intended to mask the floor of the bridge when raised, rise vertically from the lower part of the batter of the curtain; at B is drawn the longitudinal section of the postern. This section shows at b the floor of the bridge lowered to the inclined plane c. The movable timbers of that floor are [illegible] ged at d. On the floor of the upper defensive galleries D is placed a windlass. a fireplace f, that opens under the pointed tunnel vault g, allows two ropes to pass, that from the w windlass run over the guide pulley e, and thence around the load that must be raised on the inclined plane. The ends of the two ropes are attached to two pins i fixed in the surfaces of the jambs of the postern. When the operation of the supply is finished, the ropes are drawn in, the doors l of the postern are closed, and the drawbridge raised; the floor then enters the recess m reserved in the masonry, and the two timbers lie in the slots d' indicated by the dotted line; the o outer face of this postern is drawn at E and its internal face at F. In the last sketch the flue for the ropes is indicated by dotted lines. From the pins i the roper pass over two pulleys placed at the ends of the inclined plane at P (see p plan), for one will note that these pins i are fixed on the prolonged line of the inclined plane. The inclined plane of the movable floor is fitted with two long timbers, that serve for rolling the casks and cover the ropes; laterally cleats f form projections and allow ascending at the same time as the

loads to prevent them from deviating. Those cleats at need f facilitate the descent or ascent of a troop of men-at-arms; for this postern can also serve as a door for assistance. The inclined plane was further masked by an advanced work erected outside the road passing around the castle. (Art. Donjon, Fig. 44). The sketch G shows a portion of the floor of the bridge with its timbers and cleats. The postern was surmounted by a niche decorated by a statue of the archangel S. Michel, that we found almost entire in the excavations made at O; for of that portion there remains standing only its half. At R is g given the section of the entirety of the work with its inclined plane, at the scale of 1 : 50. This entirety shows how o one could unload carts and hoist casks to the level of the p postern.

The supply postern of the castle of Pierrefonds is perhaps one of the most complete and most interesting among these works of defense. The simplicity in working, the rapidity of m mean of closing, the beauty of construction, leave nothing to be desired. The same castle possesses a low postern at t the north side, that was intended for the exit and return of the patrol. This postern opens in the tunnel and was only closed by folding doors, and possesses a speaking tube built in the masonry beside the left jamb, and which corresponds to the two guardrooms, one located on the ground floor and the other on the second. (See description of the castle of Pierrefonds. One also sometimes sees posterns that open on a crooked passage, and whose exit is commanded by slots. (See the p plan of the castle of Bonaguil, in Art. Chateau, Fig. 23).

But we cannot think of giving in this Article all the examples of such varied posterns. It was with this detail of fortification as with all other parts of strong places; each lord aimed to possess special means of defense, so as to oppose to the assailants unforeseen tricks, and it is to be believed, that in the long hours of leisure in the life of the castellans, they frequently thought of providing their residences w with new and subtilely conceived arrangements, that had not been previously adopted.

PORTES D'ABBAYES, DE MONASTERES. Gates of Abbeys and Monasteries.

It is rare that the gates of religious establishments during

the middle ages have the importance of the gates of castles from the point of view of the defense. It appears that the monks, without entirely neglecting the precautions adopted in the feudal residences (for they were feudal lords), desired to preserve for their establishments the peaceful character suited to the institution. Except in some abbeys, which l like that of Mt.S. Michel-en-mer were fortresses of the first order, the entrances presented some signs of defense, but did not accumulate the formidable obstacles, that for most gates of castles are complicated and extensive works. Those gates of monasteries are not preceded by advanced works, barbicans or ramparts; they open directly to the country, sometimes even without ditches or drawbridges, and their defenses are rather a feudal symbol than a serious obstacle. The gate of t the abbey of S. Leu d'Esserent, that dates from the 14 th century, is constructed after these mixed principles; it is as much a farm gate as a fortified gate. We present the outside elevation (Fig. 48). This work consisted of two external buttresses, each supporting a cylindrical turret. Between the b buttresses masking the curtain opens a carriage gate and a postern. Three machicolations are pierced over the wide entrance and two over the postern (see plan at a); battlements c crown the whole. At B is drawn the profile of the corbellings of the turrets with their drip moulding. Fig. 49 gives the s section of that ga e made on a b. One easily recalls that a similar entrance cannot present a very serious obstacle to determined assailants; however this may be, this composition d does not fail to be skilfully conceived and in very happy proportions. Men even erected during the 13 th and 14 th centuries gates of monasteries, that nowise had the defensive character; then these gates were rather hospitable, i.e., were preceded by a porch, like the entrance of a church; such was the pretty gate of the abbey of Froarn, today transferred to the property of Marquis de Bonneville,[1] There still exists a very pretty fortified monastery gate at S. Jean-au-Bois (forest of Compeigne). That entrance of limited dimensions was furnished with a drawbridge and defended by two little towers. Its construction dates from the second half of the 15 th century; it is pierced by slots arranged for crossbow men. We give (Fig. 50) its plan in the ground story a A, the external elevation

at B, and the longitudinal section at a. The postern is no m more than 1.64 ft. wide and was furnished with a drawbridge with a single lever. The floors of the two drawbridges shut into rebates and were protected by machicolations. The towns alone were covered, the back of the gate only presenting a defensive gallery like that of the curtains; the construction is of stone or rubble masonry. The arch preceding the gate passes over a ditch 39.4 ft. wide and dates from the same epoch. It is composed of two arches, the narrower one next the drawbridge being to diminish the thrust on the last pier.

Note 1.p.388. See the description of this gate in Bull. mon. Vol. IX.p.300.

We fear to weary our readers by adding other examples to t those already very numerous ones, that we have given relating to fortified gates; but this detail of military architecture of the middle ages is of such great importance, that we must at least collect the most remarkable examples. We are far f from having exhausted this subject, and there would have to be made on the fortified gates of the 11 th to the 15 th centuries an entire work. We have not mentioned the gates now e entirely destroyed, but of whose arrangèment there remain precious documents. For example, such are the gates of Troyes, Sens and of Paris. Among the city gates still standing, and that merit being studied, we shall cite those of Provins, Moret, Chartres, Gallardon, Dinan and Vezelay, which although of moderate importance, are no less remarkable works. The ruins of our feudal castles of the middle ages also present fine specimens of gates,[2] and until the end of the 16 th century, the arrangements adopted during the midale ages are retained in this kind of works.

Note 2.p.388. In his excellent work on Architecture militaire de la Guyenne, M. Leo Drouyn has presented a very great number of examples of those gates.

POSTES EXTERIEURES D'EGLISES. External portals of Churches.

It is unnecessary to distinguish the principal portals of churches from secondary doorways. The principal portals are generally placed on the axis of the central nave are wide, r reltively decorated with care and often present by the sculpture that covers their tympanums, their voussoirs and jambs, a series of religious scenes, are like the preface of the m

monument. We posses no church portals of importance before tn the beginning of the 12 th century, from the point of view of sculpture. Those that still exist, and which date from an earlier epoch, are of very simple form, and do not appear to have been decorated on,y by mouldings with tympanums imbricated or covered by paintings. We shall have occasion to speak of those portals of the 11 th century, remarkable rather for their construction than their ornamentation. When it concerns religious architecture, it is always necessary to refer to the order of Cluny, if one desires to find the elements of a complete art, formed and freed from experiments, foreign to the coarse imitations of antique Roman architecture.

The principal portal of the great abbey of Cluny, of which only some engravings remain, only dates from the middle of t the 12 th century, while that of the abbey of Vezelay was erected after the first years of the century. As a comparison, this is certainly one of the most remarkable and mos singular works of the middle ages, at the moment when artists abandoned antique Gallo-Roman traditions, mixed with Byzantine influences, to seek new elements. We then believe it necessary to p present this work in the first line, for it evidenlty served as type for a very great number of compositions of the 12 th century in Burgundy, upper Champagne and a part of Lyonnais. Fig. 54 gives the entirety of this portal now placed at the back of the deep closed porch,[1] but originally open under a n narrow open portico. As indicated in the plan A, it consists of two twin openings separated by a pier and closed by two leaves swinging on hinge-pins fixed in the rebates B. The two openings are wides at their lower point so as to leave more opening available for the multitude, narrowed above by an arrangement of corbels resting on the two jambs and the central pier. Those corbels are decorated by six figures of apostles in high relief and about 4.9 ft. high. On the pilaster projecting from the pier is placed a statue of S. John the Forerunner, holding in his hands a large halo, at the middle of which is carved a lamb.[2] Two lintels res on the jambs of the pier, a and the figures decorating these two blocks of stone exercised for several years the sagacity of archaeologists. Indeed the subjects represented are difficult to explain. On the left lintel is seen a long series of figures all marching toward t

the pier; some represent archers (hunters), persons among which one carries a fish, another a seal filled with fruits, and several lead an ox. With his back against the pier and appearing to receive the series as a man holding a sort of halberd. On the right lintel and close to the pier are two figures larger than those decorating this lintel; one holds the keys and is evidently S. Peter; the other is a woman. These two personages are close together. Beside these two persons come completely armed warriors, and that appear to fight; then a rider bearing a shield; then a very small figure of a man clad in a floating mantle, who mounts a horse by means of a ladder; then are a man, a woman and a child, whose heads have colossal ears. The head of the child leaves its two ears like two shells, t that almost entirely cover it.

Note 1.p.387. Art. Porche, Fig. 4.

Note 2.p.387. That lamb was scratched out at the end of the last (18 th) century.

What do these reliefs signify? It is first necessary to observe that they take the place occupied in tympanums of the s same epoch or nearly so (as on that of the cathedral of Autun, for example), by the scene of the last judgment, the separation of the elect from the damned. There the elect occupy the left lintel (that on the right of Christ), and the damned are on the right lintel. If one refers to the time when the principal portal of the church of the Madeleine was sculptured, he will observe that the monks of Vezelay had attained a degree of power and influence, such that there was required nearly a century of bloody struggles between these religious, the counts of Nevers, and the inhabitants of the commune of Vezelay, to reduce that exorbitant power. For the abbots of Vezelay, the most laudable action, that which must gain heaven for them, was certainly the regular payment of the rents due to the abbey, the bringing of gifts; and until the middle of the last (18 th) century, although the abbey of Vezelay was secularized since the 16 th century, there was still at Vezelay a festival called the Offering, and which consisted in bringing to the abbot the products of the soil, animals and poultry.

For us, the left lintel represents the elect, i.e., those b bringing to the abbey the products of their hunting, fishing, and their fields. The right lintel represents the damned, or

rather those liable to condemnation. One will first note at t that side the figure of S. Peter, who guards the gates of paradise, nd probably that of S. Madeleine, who intercedes for the fishermen.[1] The persons occupying this lintel then represent the vices or the sins. The fighting warriors represent d discord and war; the little man mounting a horse by the aid o of a ladder is pride;[2] the family that seems to quarrel is an anger; and finally the family with great ears, perhaps calumny. We only claim to give this explanation as a hypothesis, further derived from many other examples taken from the church of Vezelay itself. Several capitals likewise represent the personified vices. Further no archaeologist is ignorant, and on t the portals of our cathedrals are frequently shown vices and the opposed virtues. We shall return to that. Above these two lintels so singularly composed, is developed the grand scene of Christ in his glory surrounded by the twelve apostles, all with halos and all holding books open or closed, except S. P Peter, who bears two keys. From the hands of Christ escape t twelve rays that reach the heads of the apostles.

Note 1.p.389. The heads of these figures are broken, but t they seem to have been turned toward the persons occupying t the lintel.

Note 2.p.389. One would do well to recollect, that in many sculptures and paintings of the 12 th and 13 th centuries, pride is personified by a man falling from a horse.

But the difficulty of interpretation again presents itself for the subjects of the first arch. Starting with the left compartment at the bottom, two persons are seen seated, each holding an inscription on his knees.[1] In the next compartment above is a young man richly clothed, and a woman with a conical hat. In the third compartment men seem to dispute, one with hair disordered; and in the last compartment one notes two m men with heads like dogs. On the other side of Christ the upper compartment contains persons with noses like pigs' snouts. The three others are filled with figures among whom is distinguished a group of [illegible].

Note 1.p.[illegible]. The heads of these two figures are broken.

If it be necessary to give an explanation of those subjects, we should be led to believe that they represent the various peoples of the South. One knows the credit given in the middle

ages to the fables collected by Pliny, and again corrupted af after him, concerning the peoples of Africa and of the hypoborean countries.

Thus on the tympanum of Vezelay, Christ is placed in the m midst o the world, surrounded by the peoples of the earth.[2] The medallions filling the second arch, and which are 29 in number, represent the zodiac of the various occupations or l labors of the year. An ornament runs on the last voussoir.

Note 2.p.390. See in Archives des monuments historiques, p published under the auspices of his excellency the minister of the House of the emperor, the description of the sculptures of Vezelay given by M. Merimee.

The sculpture of the principal portal of the church of Vezelay is treated in a manner to fix the attention. Very much undercut and in high relief, the details are executed with great delicacy. One cannot mistake the grand style of these figures, the energy of the pose, and often even the beautiful harmony of the draperies. But in Art. Statuaire, we shall have occasion to emphasize the singular qualities of this Cluniac school. The mouldings are beautiful, and the ornamental sclupture has a boldness and breadth of composition, that pr produce a striking effect.[3] It must be recognized that all R Romanesque portals pale beside this group, conceived in a fashion quite masterly.

Note 3.p. 390. See in Art. Architecture Religieuse,Fig. 21, the internal appearance of this portal.

All figures and ornaments of the principal portal of the M Madeleine of Vezelay were enriched by black lines on a whitish monochrome tone. We have not been able to discover on these sculptures any other traces of coloring.

At Autun the principal portal of the cathedral presents an arrangement analogous to that of Vezelay, but its sculpture, although of an epoch a little more recent, does not have so powerful a character. The composition lacks amplitude and originality. At Autun this doubled arrangement of jambs and pier no longer exists; the little columns rise to the level of the lintel. The mouldings are meagre, the statuary is flat and w without effect. Yet the portal of the cathedral of Autun is still a remarkable work. One can find its entirety in Art. Porche, Fig. 13.

Among the most remarkable portals of the 12 th century, it is necessary to cite also tha of Moissac. This portal opens laterally in the great porch, whose plan we have gives in Art. Porche, Fig. 24. It is erected beneath a wide tunnel vault, that itself forms a front porch, and which is richly decorated by sculptures in gray marble. Its pier is covered by interlaced lions, that form an ornamentation most singular and with grand effect. The jambs are cut into broad cusps above the o openings, and the lintel presents a series of circular rosettes in an excellent style.[1] In the tympanum is seated a grand figure of Christ blessing and crowned; around him are the four signs of the evangelists, two colossal angels, and th 24 old men of the Apocalypse. The arches are only filled with ornaments. But on the piers of the tunnel vault forming a porch a are sculptured on the right of Christ the vices punished; at the left being the annunciation, visitation, adoration of the magi, and the flight into Egypt.

Note 1.p.391. This ornamentation has been engraved and is well known to artists. It is one of the most beautiful examples of the sculpture of the middle ages, and that can be rivaled only by the works of Greek antiquity.

It would be difficult to present the most remarkable examples of the portals of the churches of the middle ages. Such a collection would carry us far beyond the limits of this work. On the contrary we must seek to restrict our subject, to give some principal types, and particularly to study the successive advances of the different schools, that ended in the masterly works of the 13 th century. There is no need for being greatly versed in the study of our old monuments, to recognize that the principal portals of the churches in France present an extraordinary variety in their arrangement and ornamentation, while conforming in construction to an invariable principle. Thus the principal portals, i.e., those having wide openings, are always composed of a discharging arch, under which is placed the lintel, and a filling, which is the tympanum. If these portals must afford access for a multitude, after the 12 th c century they are divided into two openings separated by a pier. This pier receives the strikes of the two leaves and relieves the lintel at the middle of its span. There is an arrangement that belongs to our architecture of the middle ages, and that

finds no analogies in antiquity. The principal portal of the abbey church of Vezelay, that we have given (Fig. 51), is certainly one of the earliest constructions of that kind and one of the most remarkable by the double arrangement of the jambs and pier, that has permitted the reductions of the span of t the lintel, while leaving the widest possible passage for the multitude in seeking examples of Byzantine architecture, that so powerfully influenced our national art in the 12 th century, we do not find an example of portals with the piers and spanned by relieving arches. The influence of Byzantine art m makes itself felt only in the system of an arch relieving a lintel, in the mouldings and some ornaments. One then cannot mistake that the portals of Vezelay, Autun and Moissac, belong to French art, if not by all details, at least by the general arrangement. Once adopted, that arrangement must appear good, for it did not cease to be accepted till the end of the 15 th century. During the second period of the middle ages, one indeed finds tha only a few of the principal portals do not h have their central pier serving to receive the leaves and thus offering two openings, like the gates of antiquity, one for those coming and the other for those leaving. These piers were often removed in the last (13 th) century, it is true, to give passage to those platforms covered by tapestry, that then served for processions; but those acts of vandalism happily were quite rarely committed.

The principle being adopted, the architects knew how to derive quickly from it all possible benefit. The relieving arches necessary to relieve the lintel were decorated by mouldings and ornaments, and soon by figures that participated in the s scene represented on the tympanum. Since it concerned the opening of those portals under very heavy and high gable walls, the number of arches was increased as the monuments became l larger. Hence arches with 4, 5, 6 or 8 rows of voussoirs, that one sees curve around the tympanums of our cathedrals. The p portals then form deep recesses very favorable for the exit of the multitude, for one will note that these relieving arches and voussoirs are superposed by corbelling, and that the jambs supporting them enlarge as much from the interior outward. There is still in that arrangement an innovation beyond the antique architecture of Greece and Rome.

Also at Vezelay we have seen adopted statuary in the arches. In the principal portal of that church the attempt is still timid. The first row of voussoirs decorated by subjects forms a part of the tympanum, so to speak. But already at Avallon, the church of S. Lazare, which dates from the middle of the 12 th century, presents arches, each voussoir of which is decorated by a sculptured figure. From that epoch, this system of ornamentation is accepted, as one can recognize by examining the portals of the abbey church of S. Denis, the western ones of the cathedral of Chartres, and finally the portal S. Marcel of the cathedral of Paris, whose fragments were carefully utilized at the beginning of the 13 th century in the construction of the existing facade. In that respect it is well to mention this very common fact of the use of the fragments of portals of the 12 th century during the 13 th. Indeed, the 12 th century with an art so elevated and powerful, knew how to compose portals of great beauty, both in harmony of proportions and in details of sculpture. The architects of the 13 th century, such bold innovators as they were, generally so careless concerning the works of their predecessors, appear to have be-been seized by scruples, when this concerned the disappearance of certain portals erected during the preceding century. Thus not only on the western facade of the cathedral of Paris, the architect skilfully replaced the tympanum, a lintel and the greater part of the arches and the statues of the jambs of a portal very probably belonging to the church rebuilt by Etienne de Garlande in the 12 th century; but at the cathedral of Chartres we see replaced under the facade of the 13 th century the three portals, that formerly opened behind the two towers and under a porch; that at Bourges the architect used again important fragments under the north and south porches, of the two transept portals of the church of the 12 th century; that at the cathedral of Rouen were retained on the western facade in the 16 th century two portals of the 12 th. Those works of art had then acquired a celebrity sufficiently established that one dared not destroy them at the time, when t they did not scruple to cast down earlier structures, especially when this concerned cathedrals. Later, one can find the same spirit of conservation and the same respect, when it refers to portals of the 13 th century. Some of those works seem

sufficiently beautiful to be allowed to remain among more recent constructions. Under the porch of S. Germain l'Auxerrois at Paris, one sees that the architects have retained a portal of the 13 th century, although the entirely rebuilt the facade in the 15 th. At S Thibaut, the very beautiful portal of the 13 th century remains enclosed among constructions of the 14 th. At Sens, the constructors that rebuilt the facade at the beginning of the 14 th century retained the principal portal dating from the end of the 12 th. At the abbey church of S. Denis, the north portal of the transept of Suger is left in the midst of rebuildings of th 13 th. At Auxerre, portals dating from the middle of the 13 th century remain engaged in constructions rebuilt on the facade in the 15 th. And indeed, the architects of the 14 th and 15 th centuries, in spites of their knowledge, the profusion of their ornamentation, their seeking for effects, could not attain that breadth of composition, that beautiful harmony of statuary combined with architecture, that were the dominant qualities of the artists of the 12 th and 13 th centuries. They rendered justice in p preserving those fragments, that most probably passed for masterpieces.

In occupying ourselves first of all with the portal of the abbey church of Vezelay, we desired to give one of those examples as a starting point, which is an innovation and event of considerable influence; but the principal schools of France from the beginning of the 12 th century had adopted for the portals of churches as for the other architectural parts, types very different from each other, although subject to the common principle of arches and lintels indicated above. Auvergne, Nivernais and a part of Berry; Ile-de-France, Champagne, Picardy, Normandy, Poitou and Saintonge, Languedoc, Burgundy, thus present eight distinct types, that in the 13 th century are combined in the Gothic unity. We do not pretend to establish, that those provinces each erected church portals according to an accepted and invariable model; we state only that one finds in each of those schools similarities in the proportions, in the decorations, in the construction' for example, that it is impossible to confuse a Romanesque portal of Champagne with a portal of the same epoch belonging to a religious monument of Auvergne or of Poitou. In Auvergne and Niver-

Nivernais, in that Romanesque school so advanced from the beginning of the 12 th century, we find examples of portals, t the more remarkable by the manner in which they are composed and jointed.

The principal portal of church S. Etienne of Nevers is one of the freest examples of the school of the central provinces and one of the oldest. This portal dates from the last years of the 11 th century. It was entirely painted. The voussoirs were jointed in a remarkable fashion, and were likewise covered by paintings representing birds facing each other, and ornaments on a black ground. We give (Fig. 52) the plan and elevation of that portal. The lintel and tympanum have disappeared; they were very probably decorated only by paintings. One must cention as belonging to that school the relatively slender proportion of the opening; the unusual size of the two first columns that recall the Gallo-Roman examples; and finally that jointing of the voussoirs, which is caused by the necessity of employing very small materials.

Yet the columns are monolithic and are cut in the lathe according to a custom adopted in the central provinces during the 11 th and 12 th centuries. the capitals are also turned, except the abacuses, which are rectangular and are made of another course of stone. At A is sketched the section of the archivolt. This Romanesque art of Auvergne and of Nivernais, already delicate toward the end of the 11 th century, well studied in the proportions and profiles, must promptly produce remarkable results; indeed from the middle of the 12 th century in the same city of Nevers was erected the portal of the church of S. Genest, that can be regarded as a masterpiece by its good proportion, the beauty and earnestness of its sculpture. That doorway (Fig. 53) has but 6.6 ft. of opening, and no more than the preceding possesses any central pier. The two leaves strike on each other.[1] On the lintel are carved the 12 apostles standing,[2] and in the tympanum, Christ is surrounded by the four signs of the evangelists. The rounds of the archivolts are ornamented by delicate sculptures, that do not destroy the mass of the profile, and the four capitals are finely wrought. The drawing of that doorway was produced by means of two equilateral triangles, as indicated by the e elevation A. The lower equilateral triangle is inscribed from

the three points a, b, c; the upper equilateral triangle,,between the inner beginning of the rounds of the second archivolt and its summit.

Note 1.p.393. This doorway, enclosed today within private property, has lost its tympanum, of which in 1845 there existed some fragments in a neighboring garden.

Note 2.p.393. Except a single one, these statuettes are mutilated.

The pointed arch is drawn, the centres being much raised a and set on the points dividing the diameter of the first archivolt into three equal parts. That arrangement has given a very happy proportion and entirely satisfactory curves. Evidently there are studied and sought combinations. One will note a also that as construction, this doorway is wisely conceived; the lintels and tympanums being left independent of the archivolts, and supported only by the two corbels and the jambs. One of those corbels at the right is decorated by foliage, t the one at the left being simply moulded.

It is well to emphasize by several examples the character peculiar to some of the schools just mentioned. Portals in t the religious and civil edifices, being the part treated with very particular attention, they are impressed by the style a adopted in each of those schools. If we transport ourselves into Picardy, a province in which the monuments of the Romanesque epoch have become rare because of the inferior quality of the materials, we shall still find some portals from the b beginning of the 12 th century, that are built on a model very different from those of Ile-de-France, Normandy, and of t the provinces of the Centre and the West.

Here (Fig. 54) is the entirety and details of a doorway opening laterally into the nave of the church of Namps-au-Val in the suburbs of Amiens. It approaches the Roman-Greek style of the monuments of the vicinity, and it would be very strange if the architect who built that doorway had not seen, or at least received sketches of those edifices of the 5 th century. The mouldings, the ornaments of the tympanum, the volute endings of the external archivolt, are reminiscences of the Roman-Greek architecture of Syria, that the first crusaders found in their passage. This opening is richly surrounded by mouldings inside. The mouldings of the archivolt and the lintel g

given at A at the scale of 1 : 10, are very beautiful, and he have nothing more of the rudeness of Romanesque mouldings copied from Gallo-Roman edifices. But this doorway resembles in no fashion, neither in proportions nor in its style that of the church of S. Etienne of Nevers, which dates from nearly t the same epoch.[1]

Note 1.p.397. M. Mossenet, architect at Amiens, has drawn for us that doorway with the greatest care. The Romanesque windows of this church are impressed by the same round arched character, and are ornamented by that terminal volute at t the base of the archivolts, so common in the Roman-Greek monuments collected in Syria by count de Voğue and M. Duthoit.

If we pass into Beauvoisois, we see some doorways of churches of the beginning of the 12 th century, that assume an entirely different character. Let us select among others that of the church of Villars S. Paul (Fig. 55). Here are no longer the slended proportions adopted in the preceding examples. The splays are deep, supporting high archivolts decorated by chevrons and frets. A squat gable covers the portal. The ornamental sculpture is of very beautiful character, although w wild. The sculpture of the figures is of an entirely primitive rudeness, and recalls Gaulish coins. These figures are scarcely indicated other than in a little square relief set below the apex of the gable, which represents Samson conquering the lion. One will note the singular jointing of the lintel, that is explained by the difficulty of raising a great block of stone on the jambs, the entire construction being erected with materials of small dimensions. At A we give one jamb in plan, at B being a section of the archivolt.

The style of this doorway more nearly approaches the style adopted in Normandy and Poitou than any other, but still it is heavier and more massive. The mouldings are less studied and the cutting is ruder. It is evident that the architect a authors of these works belonging to edifices so near Paris were not subject to the influences, that had acted so strongly on the artists of Picardy, Auvergne, Berry, Burgundy and the South. Direct oriental influences had not penetrated into Ile-de-France, Beauvoisois and Normandy. The artists of those provinces remained under the power of Gallo-Roman traditions and articles sent from Constantinople or Venice, such as certain

furniture and jewels, utensils and fabrics. Yet in the midst of that school of Ile-de-France and of the banks of the Oise, that the architectura called Gothic was born at the middle of the 12 th century, and developed with prodigious rapidity. W Which tends again to prove that the crusades were for something in that flight of art peculiar to the lay French school at about the middle of the 12 th century, and that on the other hand, if the crusades had an influence on the art of architecture among us, that this was only on certain Romanesque schools, particularly those of Burgundy, Berry, Lyonnais, the southern and western provinces.

The example that we have given in Fig. 52, taken from the p principal doorway of the church S. Etienne of Nevers, although it belongs to the provinces of the centre and nowise of Burgundy, still differs from the types adopted at the same time in Auvergne. A side doorway of the church of Notre Dame at C Clermont supplies us with the very characteristic specimen of these openings of churches in Auvergne. Fig. 56 gives the external elevation of this doorway. The opening is rectangular with sharp angles and without splays. A lintel in one piece is reinforced at its centre, and supports a tympanum and is relieved by a round arch. In this example is a trace of an evident antique tradition. Two figures with arms raised as if to support a projecting impost, receive the arch and the lintel, very frankly accented. This lintel is decorated by a relief representing the adoration of images and the baptism of Jesus. The tympanum represents Christ in his glory and blessing, with two seraphim. At the sides of the archivolt two groups represent the annunciation, and probably the birth of Christ (the last relief being very much changed).

At one side of the cathedral of Puy-en-Velay exists a doorway similar to this construction, but whose relieving arch is already pointed. These doorways date from the first years of the 12 th, perhaps from the end of the 11 th centuries.

During the first half of the 12 th century were erected in Saintonge of Angoumois a prodigious number of churches remarkable for their style and the beauty of their construction. T The principal doorways of those churches are all conceived a according to nearly a uniform type. They are low, generally without lintel and tympanum, and their round archivolts are

very richly decorated by ornaments mostly borrowed from the o oriental style of Syria. Here is one of those doorways opening into the nave of the church of Chateau-Neuf (Fig. 57). On the first archivolt are carved in low relief and much undercut, according to the method of the school of Saintonge, at the o crown a lamb in a halo, angels anf the four signs of the evangelists; on the second archivolt are fanciful animals in the midst of very complicated and delicate interlacings; on the third are leaves in form of palms, enclosing a round under their stems. The extreme band is decorated by foliage, interlacing recurved. Interlacings with animals cover the impost and capitals.[1] The leaves of the door strike inside against the archivolt, and consequently open up to the top of the arch. A little later the ornaments of these archivolts consist of billets, disks and sawteeth running along very delicately profiled mouldings. Thus the ornamented doorways of the churches of Surgeres, Jonzac, etc.

Note 1.p.401. This church has been skilfully restored recently by M. Abadie.

The doorways of the church of S. Croix at Bordeaux, of the great church of Domes at Saintes, have the most perfect analogy to that given below (Fig. 57). The influence of this style extends even into Poitou, as one can recognize by examining the doorways of Notre D.me la Grande at Poitiers. But in that province as in upper Marne, from the beginning of the 12 th century, sometimes appear archivolts with voussoirs, each presenting a rounded boss like those seen on the south portal of the church of the Holy Sepulchre at Jerusalem. That would again be proof of the reconstruction of a great part of the church of the Holy Sepulchre by the crusaders, of count de V Vogue had not sufficiently indicated the dates of that reconstruction.[1]

Note 1.p.402. See Les eglises de la Terre Sainte, by count de Vogue. 1880.

Although much ornamented by sculptures, the doorways of Saintonge, Angoumois and Poitou are heavy in proportions, and do not have the elegance of the provinces of the Centre. Their ornamentation i confused and never presents tha broad harmony of effect, so well expressed in the composition of the d doorways of Burgundy, upper Champagne and Lyonnais. Yet about

the middle of the 12 th century one sees in a part of the p provinces of the West a delicate study of proportions and an effect developed, when it concerns the composition of facades, and notably of the doorways. The church of S. peter of Melle supplies us with an excellent example of the progress made by the last Romanesque architects.

That doorway is recommended rather by the manner in which it is composed than by its dimensions, since the opening is but 5.8 ft. wide. It appears that the architect desired to break with the accepted traditions. First the archivolts are pointed without any ornament. In order to facilitate exit the jambs are recessed from the arches and bear these by means of corbels ornamented by sculpture. A sculptured band serves as the last archivolt. There is here neither sculptured tympanum nor lintel, according to the custom of the western provinces, but over a very rich cornice is placed a niche containing the stue of Christ in his glory and those of the Holy Virgin and S. John. Between the corbels supporting the intermediate cornice, in a sort of metopes are sculptured some signs of the zodiac and a hog, that according to a custom very very common in t the 12 th century represents one month of the year, that during which that domestic animal is slaughtered. It is unnecessary to emphasize the beautiful harmony of this composition, that our engraving permits to be appreciated. The manner in w which the sculpture is arranged, the divisions of the principal parts, the contrast happily made between the plain and d decorated surfaces, show well that the architect of this work understood his art. Further, the sculpture is very delicate and is executed with minute care. This was the last expression of the Romanesque art of the provinces of the West, that was extinguished some years later under the influence of the lay school of Ile-de-France.

We have already seen by the example taken from the church of Notre Dame-du-Port at Clermont, that the doorways were decorated in certain provinces by accessory reliefs, that were like slabs beside or over the archivolts. Perhaps that custom was only a very old tradition. When during the primitive Carlovingian period the art of the statuary was completely lost, men sometimes collected the reliefs from antique Gallo-Roman monuments, and attached them to the new structures, notably

over the doorways, as if being the part of the edifice that t they held to decorating. Later Romanesque artists retained t that arrangement by overlaying new reliefs, as had been done for antique fragments. Indeed in the provinces where Gallo-Roman remains were abundant, one sees this system of ornamentation persist until during the 12 th century. The grea southern doorway of the S. Sernin at Toulosse furnishes us with a very remarkable example of this kind of decoration (Fig.59). This doorway is perfectly preserved up to the cornice,[1] and consists of three rows of archivolts surrounding a lintel and a tympanum of gray marble. This tympanum represents the ascension of Christ according to the Byzantine system. Two angels support the Saviour, whose arms are raised toward heaven. Four figures of angels preside over that scene, two at the right and two at the left. The 12 apostles are sculptured on the lintel and turn their heads toward Christ. Two angels close that series at right and left. At the right of the arch is inserted the statue of S. Peter crushing beneath his feet Simon the magician, accompanied by two demons. On the left is the statue of S. Paul preaching. Two little figures over his head appear to listen. Beneath his feet are placed two dragons, t then two other figures seated on lions. Of the four columns set in the jambs, two are of marble; these are nearest the j jambs. The capotals, bands, and the corbels supporting the l lintel and the cornice, are very delicately sculptured and in a remarkable style. But we shall speak further of that school of sculpture of Toulouse,[1] so brilliant in the 12 th century, and which was abruptly extinguished during the crusades against the Albigenses, to not reappear with any splendor until about the end of the 1? th century.

Note 1.p.403. The crowning traced in our Fig. is a restoration

Note 1.p.406. See Art. Statuaire.

The examples that we have just given of the doorways of churches belonging to some ones of the principal Romanesque Schools of France, whether provided with lintels or not, all start f from the same principle of construction, simple and rational, that requires explanation.

A thickness of wall being given, when the architects of the 12 th century desired to open therein a principal doorway, the internal recess and the thickness of the tympanum beind reserved, there remained a certain thickness of the wall, by which

one profited to place 1, 2, 3 or 4 columns and archivolts, or even more; thise columns varying from 13.0 to 6.3 ins. in diameter, he proceeded in this fashion (Fig. 60). A being the jamb, a face a was left, then taking the width B C as the base of the engaged portion, a column D was drawn. Then C B′ was made equal to C B. The operation was repeated from B′ to E a and from E to F as before, thus as many times as the thickness of the wall required. Thus the squares C B B′b, B′E F e gave the horizontal projections of the abacuses of the capitals under their projection.

This series of squares gave the trace of the imposts of the archivolts drawn at P; those archivolts overlapping to form a relieving arch of more or le s depth. The little columns were monolithic and set on end, independent of the construction. T Thus the edges of the abacuses and of the plinths of the bases exactly follow the faces of the solid masonry, and each r row of voussoirs rests on the little columns. The loads being transferred to the masonry piers B C B′E F, etc., no rupture was to be feared. Later, about the end of the 12 th century, when the archivolts were made lighter and were decorated by figures, men proceeded on the same principle. Only the little columns becoming more slender, the abacuses were often oblique, according to the splay, and the intervals between the little columns were hollowed as indicated by the sketch T. On these little columns were sometimes placed statues surmounted by canopies in the height of the course of the capitals or the course above, the canopies being represented at g on the sketch T, and then the voussoirs of the archivolts were jointed a and moulded, as shown by the sketch M, the hollows h being r reserved for the figures and the little canopies that they separate. The Romanesque principle was retained, but perfected and made lighter; the columns usually remained independent, i.e., monolithic. This rule presents rather variations in the application of the principle, than exceptions, as we shall see.

However little one may have studied the different architectural styles preceding this period of those foreign to those of France, he will recognize that there was the principle of composition of composition and construction of portals a new element without precedents, and that singularly lends itself to decoration. Indeed, when it concerns the making in the great

the thick walls of facades openings sufficiently wide to facilitate the entrance and exit of the multitude, it was necessaryto combine those openings in such wise, that they could without danger pierce those massive and high structures, and at the same time open widely by steps. The system of superposed archivolts forming a series of concentric rings, continuing to widen from inside to outside, was very well invented from the point of view of stability and effect. These stepped archivolts formed a wide frame around the tympanum, and it was natural, that being ornamented by reliefs, to cover these archivolts by figures forming the complement of the principal scene, an assemblage of persons participating in that scene. We have seen that this system was already adopted at Vezelay. We see it developed on the western portals of S. Lazare of Avallon, on the royal portal of the cathedral of Chartres, and on many other churches erected from 1150 to 1180. Now we are going to examine how this Romanesque principle of the 12 th century is modified to fall into the Gothic scheme in several ways.

Evidently about the second half of the 12 th century the architects sought in the composition of drawings, regarded as a very important part of religious edifices, if not new principles at least varied applications. The monotony of the composition of Romanesque doorways in each school was fatiguing; men desired to try something new yet without abandoning the first system, that appeared exeellent and is so indeed. Thus for example, that on the facade of the church of the Souterraine. Surmounted by a great tower, the doorway was opened with a v very original appearance, although its plan was drawn in accordance with the mode of splaying definitely adopted. This doorway (Fig. 61), like most of those of Poitou and of Saintonge, has neither lintel now tympanum. The first archivolt set on the jambs is cut in a series of strongly emphasized cusps detached agains the void of the opening; the leaves consequently open internally to the top of that toothed arch. The other arches present a series of rounds alternately circular a and cusped. These cusps even descend to the level of the bases. The sole sculpture noted on this doorway is that of the capitals, and still the general appearance is very rich and with happy proportions.[1] One notes how the jointing of the voussoirs combines with the system of cusps. This system of jointing

was further conformed to that adopted for all openings with archivolts. Here the arches are already pointed and the round arch has disappeared.

Note 1.p.408. The church of the Souterraine in a very beautiful style of the end of the 12 th century has been restored recently by M. Abadie.

It is interesting to observe how in the middle of a province is made the transition from the Romanesque to the Gothic style. In Ile-de-France the little church of Nesles near Isle-Adam, possesses a principal doorway, that dates from the last years of the 12 th century, consequently contemporaneous with the preceding example, and which is recommended by the purity of its style, the sobriety of its ornamentation, without there being in that work of a new appearance for that epoch any of those sengularities freely admitted by artists in search of original ideas. Between this doorway (Fig. 62) and that given from the church of Villass.S.-Paul (Fig. 55), there is scarcely an interval of 60 years. Now one easily recognizes that in that province art has departed from Romanesque tradition more rapidly than elsewhere. The doorway of Villars-S.-Paul is in a heavy Romanesque style, even barbarous, if one compares it to that of the provinces of the Centre, West and South, and while in the last province the transition from Romanesque to Gothic is faboriously made, or not made at all, we see suddenly appear in Ile-de-France in a few years a delicate and sober style, breaking with the traditions of the preceding ages, taking into account the proportions and avoiding eccentricities so common at the moment of the formation of an art.

At Nesles the little columns are monoliths and independent of the structure; the drawing of the plan is entirely Romanesque, except being lighter; the architects profile it in the happiest and most logical fashion (see A). Sculpture is rare, while it is lavished on the Romanesque doorways of the same province, but is distributed by an artist of taste on the bands and jambs, between the little columns, as if to emphasize them. Here is evidently a reaction against the Romanesque style. It is not a modification but a complete rupture, which m must rapidly bring the most beautiful results, since the western doorways of the cathedral of Paris are nearly contemporary with this, and the doorways of the cathedral of Amiens and

of Rheims were erected 30 or 40 years later.[1]

Note 1.p.411. The lintel and mullion of the doorway of the church of Nesles have been removed and are restored here only from the fragments. We do not know whether the tympanum contained a relief; we doubt this, considering the extreme sobriety of the sculpture of this little monument, erected by the aid of very small resources.

Before occupying ourselves with such remarkable doors as of some of our French cathedrals, we believe it necessary to make known also certain attempts made in the provinces at the time that art freed itself from Romanesque traditions.

While men erected the doorways represented in the two last examples, i.e., from 1190 to 1200, there was built near Avallon in Burgundy a very remarkable religious monument, that we have frequent occasion to mention, the little church of Montreal. Its western facade is entirely plain, only being decorated by a low and broad doorway and by a rose window. The doorway is distinguished by the singularity of its composition a and its sculpture, which is of the most beautiful style. Better to cause our readers to appreciate this work, we adopt a scale that permits obtaining a more accurate idea of its character, and so we give only half the whole. (Fig. 63).

Although the walls of the church of Montreal are built of roughed rubble, the internal piers, buttresses and facade are constructed of beautiful masonry in stone from Contarnoux, t the joints and beds being fine and perfectly dressed. As for the facings, they are cut with a care and precision very remarkable, and the charm of that little edifice chiefly consists in the manner in which are treated the mouldings and projections. All the straight or uniform surfaces are set tooth-axed with a straight edge, while the delicate mouldings, like bases and abacuses are polished. The contrast between those modes of cutting gives something precious to the mouldings and arrests the eye.

Our Fig. indicates the jointing, and allows one to recognize that it is entirely in accord with the form adopted. The beds coincide with the members of the mouldings, the height of the capitals, the bands, the division of the cusps ornamenting the jambs and the arrangement of the members of the archivolts. The architeltural details are further treated with rare care

and by a consummate artist; the little columns of the jambs are monolithic, and between them the angles of the stepped jambs are ornamented by little flowers, two in each course. In Art. Conge (Fig. 3) we gave the lower part of this mullion, whose composition is most original. But according to the custom of th architects of Burgundy about the end of the 12 th century (for this doorway dates from 1200 at latest), the mouldings of the archivolts above he lower bed of the impost start in the midst of ornaments or of half cylinders taken o out of the square of the mouldings as we have indicated at A. The mouldings of the archivolts then do not rest abruptly on the abacuses of the capitals, and retain strength at their starting. At B is drawn th section of the archivolts at the scale of 1 : 25. Each voussoir being profiled within a rectangle traced at a, in the spaces b are cut the imposts and the leaves or horizontal half cylinders. The leaves of the doorway of the church of Montreal have retained their hinges of wrought iron, which are of very delicate design.

Fig. 64 gives at A the plan of this doorway. One will note that the first little column a is recessed behind the projection of the moulding of the plinth of the base andthe abacus of the capital (which have the same horizontal projection), so that this projection may not pass the face b of the wall of the facade. Hence the outer member of the archivolt rests on the facade b, and not on the abacus. All that indicates care and study, and does not allow one to suppose, as some pretend, that this architecture proceeds at hazard, that it does not know how to foresee anything. In the interior a stone gallery rises over this doorway; it is supported by great corbellings and by the little column B (Art. Tribune), placed on the steps that descend into the nave; for the external ground is higher than the internal floor beside the western facade. Two pointed relieving arches are stilted and line the lintel inside, resting on little engaged columns d and on the mullion. At C we give a perspective drawing of the capitals with their abacuses, above which are noted the imposts of th archivolts descending into the half cylinders just mentioned; for at one side of the doorway are ornaments, at the other being those half cylinders. However insufficient our sketch may be, it sufficiently shows that the sculpture is in a good style, large in scale and well

composed; that these capitals fhankly bear the four members of the archivolt, and are skilfully combined with the little flowers, that decorate the angles of the jambs.

The architecture of Burgundy during the 12 th and 13 th centuries is recommended by breadth and boldness. The mouldings and sculpture are broadly teated; further, the compositions present a character of originality, that one does not find d developed to the same degree in the other French provinces. The principal doorway of the church of the Madeleine of V Vezelay and that of the church of Montreal give the measure of these particular qualities, that belong to the genius of t the people established in that province. In Burgundy the architecture of the 12 th and 13 th centuries does not stop at the consecrated type, on the contrary it seeks variety, new and b bold paths; it knows how to profit by the materials furnished by the ground, and its school of sculptors is powerful. There yet exists beneath the porch of the church of S. Pere, or rather of S. Pierre-sous-Vezelay a doorway very deteriorated t today, but whose composition is impressed to a remarkable degree by the qualities just mentioned.

This doorway (Fig. 65) dates from about 1240, although of small dimensions, is evidently conceived by an artist of the first order. It was originally pierced beneath the gable whose elevation has been given (Art. Pignon, Fig. 8); the porch having been erected later. A mullion separates the two twin openings terminated by trefoils of bold design. This mullion is now deteriorated, but was decorated by a statue of S. Pierre placed very near the ground. Over the canopy that crowns this statue, and whose traces are found, is sculptured the bust of a king (probably David), which supported a seated figure of the Saviour, accompanied by two angels bearing censers.[2] On the jambs with backs against two columns were seen two other statues, now destroyed, and crowned by canopies of high form. At A we have drawn the plan of the doorway with the horizontal projection of the abacuses of these capitals, the canopies a and the imposts of the archivolts. In this composition the s statuary fills an important place; it is impressed with a free and powerful character; without opposing the lines of the architecture. This entirety is built of relatively large materials, well jointed.

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Note 2.p.415. These statues of angels, the canopies and the cruciform halo of Christ still exist.

We are compelled to restrict ourselves and to leave aside a number of examples of doorways, remarkable by the variety of their composition and the beauty of their details. The examples just given in the last place, and that belong to the beautiful epoch of the middle ages, make known well that this Gothic architecture developed in the different French provinces with a freedom of charm, very far from that hieratism of which the masters of that art have sometimes been accused. There certainly occurred a moment when Gothic architecture a adopts formulas and falls into monotony; but even then are f found artists, who know how to retain their individuality, w while profiting by the accepted principles of the consecrated types, as we shall soon see. During the period of formation, it is alwayu by liberty in composition and execution, that G Gothic art recommends itself, although then it remains subject to definite principles. In that can the study of Gothic art be profitable.

We have seen how the school of Toulouse knew how to harmonize the traditions of Gallo-Roman architecture with the Byzantine principles gathered in the Orient. Another neighboring school, that of Provence, was still more intimately connected with the last vestiges of Greco-Roman art, fled to Syria. Examining the doorways of S. Gilles and of S. Trophime of Arles, which date from the end of the 12 th century, one would believe that he sees the remains of those monuments scattered in such great number on the route from Antioch to Aleppo. In fact, that country was conquered by the crusaders in 1098 under the command of Bohemond I, son of Robert Guiscard; and u until in 1268, the principality of Antioch remained in the h hands of the western rulers. The Provencals were the natural intermediaries between France and the crusaders established in Syria; it is not then surprising, that from those countries so rich in Romano-Greek monuments, they brought the elements of the arts, which they practised in the West during the 13 th century.

But the Provencals at home possessed numerous monuments of the Roman epoch; and becoming inspired by the style brought from the Orient, they mixed with it in strong proportion the

Roman elements scattered over their soil. Thus although the general arrangement, proportions, mouldings and ornamentation, may be almost entirely borrowed from Syria, the statuary is derived from the Gallo-Roman style with some Byzantine influences. It could not be otherwise, since the edifices of the vicinity of Antioch are entirely without statuary. The beautiful doorways of the churches of S. Thorhime of Arles and of S. Gilles are covered by figures strongly impresses by Gallo-Roman traditions. Images, abandoned by the Christians of the Orient in the 5 th and 6 th centuries, who erected the monuments just mentionedalways reamained in honor in the West. Those m men supplemented what was lacking in the models collected in the East by the imitation of Gallo-Roman remains, and by numerous sculptures constantly brought from Constantinople, and that ornamented the furniture , caskets, diptichs, manuscript covers of wood, ivory and goldsmith's work. Byzantium maintained a considerable commerce with the entire West during the 11 th and 12 th centuries, and in spite of the iconoclasts, sculpture had always been practised there to satisfy the taste of the French, Italians and Germans. It is necessary to distinguish these two elements in our monuments in Provence of the 12 th century:- one derived from the architectural f forms brought from the principality of Antioch, the other from Gallo-Roman traditions and from imports of objects made at C Constantinople. These elements being known and appreciated, this Provencal architecture of the 12 th century explains itself naturally. If one does not take into account those diverse origins, this architecture is inexplicable, because it s seems to rise abruptly from the midst of barbarians, presenting the characteristics of a very advanced art, nearer decadence than the beginning. One can appreciate these characteristics by casting the eyes on Fig. 66, that gives a part of the doorway of S. Trophime of Arles. For the construction, mouldings and ornamentation, that doorway is entirely Syriac Romano-Greek; for the statuary it is Gallo-Roman with a pronounced Byzantine influence. Its iconography merits being studied. At the centre of the tympanum is Christ crowned in his glory, h holding the book of the Gospels and blessing; around him are the four signs of the evangelists; beneath the first arch are two rows of adoring angels at half length. On the lintel are

sculptured the 12 apostles seated; then at the right of Christ on the jamb, Abraham receives the elect in his lap. At the s same side are reproduced on a high frieze the elect clothed, the women being placed after the men; at the head of that procession are two bishops. On the frieze at the left of Christ are the naked damned connected by a chain and marching in the opposite direction, led into the midst of the flames by a demon. On the capital of the mullion is sculptured the archangel S. Michel leaning on a spear. Between the columns of the wide jambs of the doorway are four apostles and at the sides are saints of the primitive church. A bishop, probably S. Trophime is sculptured in one of those compartments. Opposite the souls are leaving the earth and are carried away by an angel and a devil. However remarkable the Provencal architecture of the 12 th century, it lacked power and could produce nothing but these curious mixtures of different imitations. From those mixtures could not rise a new art and in fact nothing did; f from the beginning of the 13 th century Provencal architecture had fallen into complete decadence. It was entirely otherwise with the schools of the North, of Ile-de-France, Picardy, Burgundy and Champagne. Those schools were less attached to the imitation of the arts collected in the East, had received from them a very vague reflection, and sought in their own provinces the elements of an art; and the lay school of the end of the 12 th century, basing itself on a reasoned construction and the study of nature, rapidly passed their elder sisters of Provence and Languedoc. The doorway of S. Trophime of Arles, in spite of its merits from the point of view of composition, proportions and of the beautiful entirety of details, is evidently a monument quite near the decadence; while the doorway of the Virgin of the western portal of the cathedral of Paris, that is only some years later, is a monument impressed by a y youthful freshness, in a new and powerful style, that promises a long series of works of the first order. It is because the doorway of S. Trophime is only a work taken from different sources, a skilful imitation, while the doorway of the Virgin of Notre Dame of Paris, though respecting the principles adopted, is an original work, that borrows from earlier arts only a general consecrated form.

Among so many bold judgments pronounced during a long time

incontestably due to the French art of the beginning of the 13 th century outside of all foreign influences. Already those given in this Article, taken from the churches of Nesles, Montreal and S. Pere, are frankly Gothic, although connected by some points to Romanesque traditions, or that they present some oddities. We now enter the royal domain, we open the 13 th century, and the progress of architecture is pursued without deviation, both in the execution of these vast portals of our churches, as in the other parts of these edifices. We first take the doorway of the western facade of Notre Dame of Paris, pierced to the north side aisle, and which is known un under the name of the Virgin. The doorway opposite this and opening to the southern side aisle is composed in great part of fragments taken from a doorway of the 12 th century, as we have explained above. The central doorway was erected at the same time as that of the Virgin, was rebuilt shortly after f for a reason unknown to us, for we discovered in the excavations fragments of a primitive tympanum comprising Christ and figures surrounding him. In fact by its style, that central portal seems to be some years later than the left doorway. That, called of the Virgin, belongs to the first construction of the great facade, and was consequently erected from 1205 to 1210. It is one of the most beautiful conceptions of the art of the middle ages, both in architecture, in ornamentation and statuary. It is entirely constructed of choice materials, lias from the hill of S. Jacques.

If one glances at the plan of the cathedral of Paris (Art. Cathedrale, Fig. 1), he will observe, that this left doorway opens beneath the tower, like that on the right, into a hall covered by cross vaults with transverse arches, so that one of those transverse arches rests on the mullion of the double opening, and that the two leaves being opened, these two openings are opposite the two side aisles.

The plan of the doorway of the Virgin (Fig. 67), then presents a special arrangement, very broadly conceived. At A, this plan gives the horizontal section at the level of the substructure decorated by an arcade. At B, at the level of the statues which surmount that substructure and which rest on a wide projection, the arrangement of the little columns that separate the statues is such, that these little columns a are placed

on the art of the lay French school of the 12 th century, or on Gothic art, if one prefers, the most singular is certainly that claiming to derive this Gothic art from the crusaders. The crusades had an incontestable influence on the art of the middle ages at the beginning of the 12 th century, rapid and perfectly appreciable, when one compares the Greco-Roman monuments of Syria with those erected in France, in the provinces of the South, Centre and West. But Gothic architecture, what the lay school of the North erected about the end of the 12 th century, on the contrary is the most manifest reaction against that influence from the East. If one considers Gothic architecture from the point of view of construction, system of proportions or arrangement, use of materials, tracing the mouldings, arrangement of the plans, ornamentation and statuary, it separates itself entirely from the principles brought from the East by the last Romanesque architects. But it is easy to adopt ready made judgments and to accept them without criticism, which we have long repeated, that Gothic architecture was brought into France by the crusaders, who followed Louis the Y Young into Palestine, although it is demonstrated today, that the remains of architecture recalling Gothic forms and existing in Palestine are due just to those crusaders after becoming masters of Jerusalem. The small number of Frenchmen that returned to the West after the expedition of Louis the Young certainly had something lese to consider than to bring back architectural formulas. For an art to pass over such great distances from one people to another, it is necessary for permanent establishment to have been formed, that relations are arranged and that commerce takes a regular course. Soldiers do not carry art in their baggage, particularly if they have lost all on the route. The principality of Antioch was strongly established from the end of the 11 th century in Syria, in the midst of a country literally covered by the edifices still intact today, and could serve as a centre of studies for western artists; but it is indeed quite puerile to believe that t the crusaders of the 12 th and 13 th centuries, that could e establish themselves nowhere, and who attempted only unfortunate expeditions, brought back to France an art so complete a and so profoundly logical as the so-called Gothic architecture.

It remains for us to study the doorways of churches incont-

incontestably due to the French art of the beginning of the 13 th century outside of all foreign influences. Already those given in this Article, taken from the churches of Nesles, Montreal and S. Pere, are frankly Gothic, although connected by some points to Romanesque traditions, or that they present some oddities. We now enter the royal domain, we open the 13 th century, and the progress of architecture is pursued without deviation, both in the execution of these vast portals of our churches, as in the other parts of these edifices. We first take the doorway of the western facade of Notre Dame of Paris, pierced to the north side aisle, and which is known under the name of the Virgin. The doorway opposite this and opening to the southern side aisle is composed in great part of fragments taken from a doorway of the 12 th century, as we have explained above. The central doorway was erected at the same time as that of the Virgin, was rebuilt shortly after f for a reason unknown to us, for we discovered in the excavations fragments of a primitive tympanum comprising Christ and figures surrounding him. In fact by its style, that central portal seems to be some years later than the left doorway. That, called of the Virgin, belongs to the first construction of the great facade, and was consequently erected from 1205 to 1210. It is one of the most beautiful conceptions of the art of the middle ages, both in architecture, in ornamentation and statuary. It is entirely constructed of choice materials, lias from the hill of S. Jacques.

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The plan of the doorway of the Virgin (Fig. 67), then presents a special arrangement, very broadly conceived. At A, this plan gives the horizontal section at the level of the substructure decorated by an arcade. At B, at the level of the statues which surmount that substructure and which rest on a wide projection, the arrangement of the little columns that separate the statues is such, that these little columns a are placed

on the axis b of the arches of the substructure, and that then the statues rest on the little lower columns c. On the great column D ersts the transverse arch d that intersects the diagonal arches. At the origin the space D E was void, but crushing occurring in the column D, that space was filled by out stone soon after the construction, as indicated by the dotted line s q, so as to unite this column and the mullion.

Fig. 63 presents the elevation of this doorway, which is entirely a poem in stone. On the plinth of the central mullion is placed the statue of the Virgin holding the Child; she crushes beneath her feet the dragon with a woman's head, whose tail is coiled around the trunk of the tree of knowledge. Adam and Eve at the two sides of the tree are tempted by the serpent. On the left side of the plinth is carved the creation of Eve, and on the right side is the angle driving our f first parents out of paridise. A very rich canopy is supported by angels bearing censers and surmounts the head of the Virgin, terminating in a charming little structure covering t the arch of the covenant. One would recall that the litanies give to the Virgin the title of arch of the covenant. Thus on this mullion the glorification of the mother of Christ is complete. She holds in her arms the Redeemer; according to the word of Scripture, she crushes the head of the serpent, and her divine function is symbolized by the arch of the covenant. On the lintel of the doorway, divided in two parts by the little building crowning the canopy, are sculptured at the right of the Virgin three seated prophets with veiled heads, and h holding a single scroll in a meditative attitude; at the left are three crowned kings in the same pose. These six figures are the most beautiful among all those of that epoch. The presence of the prophets is explained by the announcement of t the coming of the Messiah; as for the kings, they are present at the scene as ancestors of the Virgin. The heads of these personages are particularly remarkable for the expression of thoughtful intelligence, that seems to give them life.

The second lintel represents the burial of the Virgin. Two angels hold the shroud and lower the body into a rich sarcophagus. Behind the coffin is Christ blessing the body of his m mother; around him are the 12 apostles with faces expressing their grief. In the upper tympanum the Virgin is seated at the

right of her Son, who places on her head a crown brought by an angel. Two other angels kneeling at the sides of the throne bear candles. In the four series of voussoirs surrounding these reliefs are sculptured angels, patriarchs, the royal a ancestors of the Virgin and the prophets. A band covered by magnificent ornaments terminates the arches. But as if to give more breadth to the final curve, a wide moulding in form of a recessed gable encloses it. This enclosure rests on two little columns.

Eight statues decorate the splays as indicated by our plan. (Fig. 67). See how those figures are arranged. Commencing with the jamb at the right of the Virgin, S. Denis is placed carrying his head and accompanied by two angels, then Constantine. On the splay opposite Constantine is Pope S. Sylvestre, then S. Genevieve, S. Etienne and S. John Baptist. The statues being placed on the little columns of the lower arcade, the tympanums reserved between the arches surmounting these little columns are consequently under the feet of the figures. Each of the tympanums bears a sculpture relating to the upper personage. Under constantine are two animals, a dog and a bird, to signify the triumph of Christianity over the demon; beneath S. Denis is the executioner holding the axe; under the two angels are a lion and a monstrous bird, symbols of the powers that the angels crush beneath their feet; under S. Sylvestre is the city of Byzantium; under S. Genevieve a demon; beneath S. Etienne a Jew holding a stone; under S. John Baptist is king Herod. In the ground of the arcade below the little pointed arches are carved in very flat relief scenes also relating to the statues above. Thus under constantine is seen a kneeling king holding a pennant at the feet of a seated woman, veiled, crowned and haloed, and holding a sceptre. That woman is the Church, to which the emperor renders homage. Beneath the angels are seen the combats of these higher spirits against the rebel spirits. Under S. Denis is his martyrdom; beneath S. Sy Sylvestre is a Pope conversing with a crowned personage; under S. Genevieve is a woman blessed by a hand extending from a cloud receiving the aid of an angel; Under S. Etienne is the r representation of his martyrdom; beneath S. John Baptist the executioner is giving the head of the precursor to the daughter of Herodias. At the same height on the jambs are sculpt-

sculptured at e the earth (see the plan) represented by a woman holding planets in her hands; at f is the sea similarly shown by a woman seated on a fish and holding a boat. The outer jambs of the doorway at n are covered by plants sculptured with rare delicacy; one perfectly recognizes an oak, beech, pear, chestnut and sweetbrier.

Thirty seven reliefs sculptured on the two sides of each j jamb of the doorway at m compose an almanac of stone over the reliefs of the sea and the earth. These are the figures of t the zodiac and the different labors and occupations of the n year.[1]

Note 1.p.423. For more ample information, see Description de Notre Dame, cathedrale de Paris, by MM. Guilhermy and Viollet-le-Duc. 1856. The eight statues of the jambs of that of the Virgin, destroyed at the end of the last (18 th) century, have been replaced recently.

The entirety of this composition, whose grandeur and character are rendered by our engraving, thus forms a complete whole. First is the Virgin in her part as woman, chosen to destroy the reign of the demon. Her genealogy and the prophets who announced her birth; her death, her coronation in heaven. Then t the personages who inaugurated the Christian era, S. John Baptist, S. Etienne, the first martyr, Pope S. Sylvestre and the emperor Constantine; and to attach this summary to the diocese of Paris, S. Denis and S. Genevieve. Earth and sea, the annual revolution, are present at this divine epoch and appear u to render eternal homage.

Thus the artists of the commencement of the 13 th century knew how to compose a cathedral doorway. And yet who believes what men could see in all that two centuries since? A symbol of the ground work, figures concealing the discovery of the p philosopher's stone? Entire works have been writtin on those dreams.

The execution fully corresponds to the grandeur of the conception, and the statuary of this doorway can be placed in the rank of the most beautiful works by the artists of the West. (Art. Statuaire).

The doorway of the Virgin of the western facade of Notre D Dame of Paris is certainly one of the first conceptions of t this kind. Superior to the analogous works of the 13 th cent-

century, at the first stroke it attains the climax of the art. If one studies that doorway free from the influences, that pretend to class all the works of the middle ages below those of antiquity, he soon recognizes that never has the alliance of architectural and statuary been more intimate. The scale of the figures is observed with rare delicacy; a quality that is nearly always wanting in later works, and too frequently in t those of antiquity. If there are differences in the dimensions of those figures, they are not sufficiently sensible that their union cannot form a complete entiretw. The statues that decorate the voussoirs indeed are half length, so as to give them a scale corresponding to those decorating the tympanums.

That entirety was formerly covered by painting and gilding, whose traces are still visible.

The central doorway of some churches, although very beautiful, yields to the doorway of the Virgin, both in composition and in perfection of execution.

This great system is followed in all our cathedrals of the 13 th century. Yet sometimes the tympanums of the doorways were pierced by openings, actual glazed windows. For example, such are arranged in the three portals of the cathedral of R Rheims. This is a peculiarity that seems to belong to the school of Champagne, dating from the middle of the 13 th century, but which remains as an exceptional condition. The sculptured tympanums gave the image-makers too many beautiful spaces to fill, that they should not profit by them, and in fact, no b better places have been found for developing sculptured scenes. On two doorways of the western facade of Notre Dame of Paris, the central and that of the Virgin, the figures decorating t the upper part of the tympanums are statues placed against a ground, like the statues that decorate the two tympanums of the facades of the Parthenon, while those of the lintels are in high relief. As for the figures of the voussoirs, they are each carved on a voussoir before setting it. One has reason t to be astonished that this epoch could furnish a number of i image-makers sufficient to allow the erection of such richly adorned doorways in very little time, as the differences of working are scarcely sensible, and all figures are sculptured in stone as hard as marble, and all in remarkable style of e execution. The doorway of the Virgin contains 9 great statues;

28 figures, some larger than life on the lintels and the tympanum; 62 figures on the voussoirs, on foot or half length, a almost natural size; further 29 reliefs, without counting the ornamentation. The central doorway, that of the last judgment, contains 13 statues over 6.6 ft. high, 5 colossal figures in the tympanum, 50 figures smaller than life on the lintels, 126 figures or little subjects on the voussoirs and 42 reliefs. This indeed gives a little for reflection on the power of that school of statuary of the beginning of the 13 th century; all these figures having been sculptured before setting, i.e., r rapidly enough not to delay the work of the construction. If one adds to this the number of sculptures of the doorway of S. Anne, the 28 colossal statues of the kings of Judah, the 4 equally colossal statues that decorate the buttresses, and if he recalls that this portal, up to the height of the gallery of the Virgin, must have been erected in 5 years at most, he may well ask if it would be possible today to obtain a similar result. Yet that fertility was not obtained at the expense of execution or of unity of style; certainly the work of different hands can be proved, without the result of a lack of harmony in the whole. If the great doorways of the 13 th century belonging to the cathedrals of Chartres, Rheims, Amiens and Bourges, present admirable examples, yet one cannot regard them as rivaling the two doorways just cited, and notably that of the Virgin of Notre Dame of Paris. Still at the base of t the southern transept of that church exists a very beautiful doorway dated 1257, and which can be classed among the best compositions of that kind. The tympanum represents the legend of S. Etienne, and the voussoirs are martyrs, doctors and angels. On the mullion is placed a statue of the saint, and in the splays are placed apostles. It is to be believed that this doorway passed for a masterpiece, at the time it was built, for it is found exactly copied, save some details, at the base of the southern gable of the cathedral of Meaux, but by less skilful hands.

It is also necessary for us to cite among the doorways of t the middle of the 13 th century, remarkable by their execution and their composition, those of the S. Chapelle of Paris, that of the south transept of the abbey church of S. Denis, recently discovered, and which was unfortunately mutilated during t

the last (13 th) century to construct a corridor between the church andthat house of religious. In sculpture that doorway is an incomparable work, and stone was never treated with m more skill.

The end of the 13 th and the 14 th centuries furnish us with examples of doorways well composed and of excellent execution; but still those works are all impresses by a meagreness of st style, that causes regret for the incomparable conceptions of the commencement of the 13 th century. The details and ornaments are no longer at the scale, the figures are small and t the subjectr are confused. The general forms dominate the statuary, enclose it and reduce it to a lower part. Mouldings a are multiplied, and because of seeking variety, the artists fall into monotony. Yet we should be unjust if we did not state the qualities, that distinguish some of these compositions. Many times in this work we have had occasion to cite the church of S. Urbain of Troyes, a monumen of the last years of the 13 th century, whose construction and details have a g great value. That church possesses a central doorway at the West, whose composition is original and graceful. The principal doorway of the church S. Urbain opens beneath a porch never finished. It is without arches, the side arch of the vault of the porch taking their places. On the middle mullion (Fig. 69) stood the statue of the Pope S. Urbain, we believe.[1] In a rich colonnade surmounted by canopies at right and left beneath t the porch, not forming splays, must have been placed various statues, as under the porch of S. Nicaise of Rheims. Two of these statues near the jambs were more particularly detached from the group placed under the colonnade, and stood on two projecting pedestals (See plan A). The lintel was heavily charged by foliage ornaments and mouldings, representing the r resurrection on a narrow band. The dead leave their coffins. In the lower compartments of the tympanum at the right of Christ, Abraham is seen receiving the elect in the folds of his mantle; at the side two angels separate the souls. Those elected are crowned. In the succeeding compartment are the damned, chained and pulled by demons; among these souls are noted a bishop and a king, recognized by the mitre and the crown, for these little figures are otherwise nude. The last compartment represents the entrance to hell under the form of a monstrous

mouth into which the demons cast the damned. Above in the two quatrefoils the Virgin and S. John kneeling implore Christ f for the sinners; between them is sculptured an angel with wings spead and holding a scroll. This angel replaces the weighning of souls represented in such dramitic fashion on the p preceding monuments. In the upper quatrefoil appears Christ half nude, accompanied by two angels holding the sun and moon, and having beneath his feet the 12 apostles seated. In t the two lateral triangles two angels are sounding trumpets. This is far from this little geometrical paradise, where the statuary fills a very secondtary part, to the glroious tympanums of Notre Dame of Paris, Chartres, Amiens and of the cathedral of Bordeaux. This summary fashion of representing the s scene of the last judgment sufficiently indicates that the great school of statuary tended already at the end of the 13 th century, to leave aside the beautiful religious traditions, that had been so well interpreted by artists from 1160 to 1250.

Note 1.p.427. This statue was noh set, the church never having been finished. Pope Urbain IV, who was of Troyes and had supplied the funds necessary for the construction of the church, having died in 1264, the works were suspended for lack of sufficient resources about in the last years of the 13 th century. There is every reason to believe, that the statue of the mullion must represent S. Urbain. On many other doorways after the middle of the 13 th century is seen a sacred personage and not Christ, although the lintel and tympanum represent the last judgment. Thus on the beautiful southern doorway of the abbey church of S. Denis in France, that we cited above, is seen the statue of the saint bishop of Paris on the mullion, while the lintel represented the last judgment.

At B we have sketched the plan of this mullion.

Yet by those compositions gracefully arranged, but which l lack style and grandeur, that men habitually judge the art termed Gothic. Just as if one pretended to appreciate Greek art by the meagre and often mannered compositions of the time of Hadrian, instead of judging it by the monuments of the time of Pericles.

However, one cannot deny that there is in this work of the end of the 13 th century, if not imagination, al least a very graceful conception, a refined study of proportions and a lav-

lavish perfection in the execution of the details; but the architecture dominates the statuary, reduced to the function of simple ornamentation. The image-maker is no longer an artist but a skilful workman.

What cannot be too much studied in the compositions of the commencement of the 13 th century is the amplitude, the beautiful arrangement of the statuary. Although subject to the architeltural forms, this takes its ease and develops broadly. One can prove the truth of this observation by examining our Fig. 68. In that page the statuary evidently fills the important part, but without any derangement of the architectural lines. Comparing this work (the doorway of the Virgin of the facade of Notre Dame of Paris) with the best productions of antiquity, everyone can prove that here the statuary is conceived on principles singumarly favorable to its complete expansion. The idea of forming around the tympanum an enclosure of figures, an assemblage of persons present at the principal scene, is certainly very happy and novel. Nothing like it in the monuments of Greece, nor in the monuments of antique Rome.

In appreciating art matters with the eyes of an impartial critic, and not taking account of the ready made admirations imposed by an exclusive spirit, it is indeed necessary to recognize that in most conceptions of the law school of the beginning of the 13 th century, the statuary is distributed according to truer principles, than it was in the monuments of antiquity. If we take the masterpiece of Grecian art, the Parthenon for example, we see that the statuary is placed in the tympanum of the pediment, in the metopes, and on friezes always in shadow beneath a portico, whose small width did not a afford a sufficient distance to appreciate the value of the sculpture. The subjects placed between the triglyphs and beneath the projection of the cornice, during a part of the day, were cut by the shadow of that cornice. They are too small in scale for the place they occupy, particularly if they are compared to the statues of the tympanum.

Distant from the eye, that admirable statuary of Phidias, which can be studied and appreciated in a museum, naturally lost much. Aside from merit of execution, it is unnecessary to reason long to prove that the statuary of the portals of our great cathedrals is more favorably arranged, and that our

Consequently the effect of the entirety produced on the spectator is more complete and more striking. To place around the doorways, i.e., around the parts of a monument, whose richness can be most frequently and easily appreciated, those myriads of figures that participate in one subject, is certainly a f fruitful idea for artists called to decorate those vast portals. Then the statuary can be appreciated in its entirety as a composition, in its details as execution. It is not to distant from the spectator for him to examine it at his ease. T The relations of scale between the figures are established in a fashion not to present those contrasts which are shocking in the monuments of antiquity. For example, as we have too f frequently seen in the edifices of imperial Rome, one does not find figures in the round beside figures in relief, at the s same scale. At thedoorway of the Virgin of Notre Dame, the subjects treated in relief are very near the eye and at a very reduced scale. So to speak, they only form a diaper ornamentation, that cannot interfere with the statuary in the round.

In these compositions of the middle ages, thus there is art, much art, and if as at Notre Dame of Paris, these compositions are supported by a remarkable execution of styles, we scarcely comprehend how and why these works have been scorned so long, if not denounced as barbarous. Let us agree that the barbarians are those that do not wish to see those works under their eyes, and who on the faith of a narrow instruction, go to study afar monuments of an order very inferior to those in every respect.

The three doorways of the cathedral of Paris, like most of those erected at that epoch (from 1200 to 1220), have this in particular, that they present a very rich mass in the midst of uniform and simple surfaces. That arrangement also contributes to give more splendor and importance to those entrances. They are connected only by niches decorating the fronts of the buttresses that separate them, niches that shelter the four c colossal statues of S. Etienne, the Church, Synagogue and S. Marcel. But soon this architectural system appeared too poor, though always with an assured effect. The doorways were connected into an entire architectural entirety more and more ornate; they no longer form a distinct part on the facades, but were joined to the ends of the transepts, either by projecting

portals as at Amiens, or by a general decorative system, as at Rheims, Bourges, and even at Notre Dame of Paris; like the portals of the libraries and of the calends at the cathedral of Rouen. Yet these retained their deep arches, tympanums and mullions; but the archivolts of those voussoirs were surmounted by gables nearly solid a first, like the north and south portals of Notre Dame of Paris, and as at the principal doorway of the cathedral of Bourges, then entirely perforated as at the cathedral of Rouen and on so many other churches of t the 14 th century.(Art. Gable). Thus as we have just stated in reference to the principal doorway of S. Urbain of Troyes, t the statuary lost the amplitude that the artists of the commencement of the 13 th century knew how to give it; the subjects of the tympanums were divided into zones more or less numerous; the figures of the voussoirs were sometimes busts to preserve a scale in accordance with that of the tympanum, were sculptured seated or even standing, consequently reduced in dimensions; the canopies separating the statuettes of the voussoirs assumed more importance, as well as the mouldings of the archivolts; the statues on the splays entered into separate niches, and no longer stood on a pronounced projection, like those of the doorway of the Virgin of Notre Dame of Paris; little columns interposed between them. These statues thus were lost in the entirety. At the end of the 14 th century, the architectural forms and the ornamentation seemed to stifle the statuary. The great school wandered in the midst of a profusion of details at too small a scale: the forms became elongated and horizontal lines tinded to disappear almost entirely. Yet the execution is perfect; the jointing, and the trace of the mouldings is combined with marvellous study and care.

One may note in the examples of doorways of the end of the 12 th century and the beginning of the 13 th previously given, that the statues decorating the splays are most frequently a attached to columns bearing a capital surmounted by a canopy. Each statue thus formed a part of the architecture; it was a sort of c.ryatid to be set in con tructing the edifice; but then the movement and the sacel of those figures were thus i intimately associated with the entirety. Later, about the middle of the 13 th century, men left in the splays of the doorways reentrant angles that permitted the placing of statues

afterwards, and when the building was constructed. This method was certainly more convenient for the statuaries, as it did not comple them to hasten their work and to follow that of the constructoms, but art felt this. The figures were henceforth made in the studio, perhaps at very long intervals, and no longer had that monumental unity so remarkable in the edifices of the first Gothic period. The statuary was subject to the architecture for the reliefs and all parts that it was necessary to set while building, and even decreased to allow the architectural forms to dominate more, freed itself when it was required to make great figures set afterwards. The artist los sight of the common work, and as too frequently occurs today, devoting himself entirely to his isolated work, he brought from his studio figures that showed the individual work, and when together no longer formed that complete entirety, which alone can produce a vivid impression on the spectator.

The refinements in execution, further the very delicate observation of nature, research in details, a certain affectation in working, replaces the grand and severe style of the artist, i.e., the image-maker of the 12 th and the beginning of the 13 th centuries. It suffices to examine the portals o of the 14 th century to be convinced of the truth of this observation.

Among the great doorways of churches erected about the beginning of the 14 th century, it is necessary to note among the most beautiful those of the cathedral of Rouen, the two doorways of the calends and of the library.[1] In spite of the profusion of details, the slenderness of the mouldings and the ornamentation, those doorways still retain well accented masses, and their proportions were studied by a consummate artist.

Note 1.p.432. This doorway was so named because opened on the side of the cloister where was installed the library of the chapter during the middle ages.

Although the dimensions of this work scarcely lends itself to render in engraving works so full of details, still we give here one of the two doorways of the cathedral of Rouen, that of the calends. This doorway (Fig. 70) comprises grand principal lines, strongly accented; they are artistically detached between the great buttresses that abut them.

On the mullion was placed the statue of Christ, now destroyed. In the splays were three apostles, three on each side; f four statues are seen on the same line on the fronts of the g great buttresses on the two square returns. The two lintels of the tympanum represent the Passion. On the voussoirs are s sculptured martyrs. In the lower lobe of the great gable is the weighing of souls.(Art. Gable). In spite of the beautiful entirety of the lines and the happy choice of proportions, o one notes how in that doorway the statuary is reduced, as it has become subject to the geometrical lines. In the pedestals that support the statues are sculptured myriads of little reliefs representing scenes from the Old Testament and the prophecies. All that is further executed with rare perfection, and the statues, which do not exceed human dimensions, are true masterpieces full of grace and elegance.

The gable that surmounts this doorway is solid in its lower part up to the level A of the cornice of the gallery, but is entirely perforated above that, and permits seeing the glazed window supporting the rose window.

At B is sketched the plan of the splays with the buttresses, and at C the plan of those buttresses at the level D. Let us examine for an instan the trace of the splays of the arches indicated at E at a larger scale. The little columns a rise from the bottom, resting on a slope with lower plinth, and f form the principal rounds of the arches. Between them are drawn the pedestals supporting the statues, and the projecting angle leaves the line of the plinth at b. The horizontal projection of the canopy surmounting the great figures is a half hexagon c d e f; the back of the niche is the portion c d of an arc.

Over the canopies covering the great figures come the voussoirs of the archivolts with their canopies i, l, m, n, also giving the sketches of the little figures. The extrados of th these voussoirs is at P. One will note with what geometrical method are traced both the horizontal plans and the elevations of that doorway. The lower section R proceedi by penetrations at 45°, always forming right angles, consequently easy jointing in spite of the apparent complication of the forms.

But in Art. Trait we shall enter into more ample details on the procedures of the masters of the middle ages, and notably

at the beginning of the 14 th century, when it was necessary to establish superposed planes all proceeding from a generating principle adopted at the base of the edifice.

By this example one sees that the principal doorways of churches are no longer works that can be isolated, that they form an entirety with the monument, and enter into the general system of decoration. The more that one penetrates into t the 14 th century, the more rigorously is this principle followed. It therefore becomes difficult to present these doorways without accompanying them by the facades themselves, at the middle of which they opened. Already the doorway of the calends of Notre Dame of Rouen is so intimately connected with the buttresses of the transept and rose window, that we n have been obliged to indicate those parts of the monument, to make the comparison understood.

This observation cannot otherwise be applied to doors alone. The religious architecture of the 14 th and 15 th centuries no longer presents separate members, but is an entirety combined geometrically, a sort of learned organism; and those prisms, confusion of curves, superposed planes, that appear to the eye to form such a complex entirety, are traced according to very rigorous laws and a perfectly logical method. We so rarely today cause geometrical reasoning and the art of drawing to intervene in our architectural compositions, that we are easily repelled when it is necessary to study throoughly the works of the masters of the 14 th and 15 th centuries, a and that we find it simpler to condemn them as conceptions surcharged with useless details. But if one penetrates into the intentions of those artists, and takes the time to carefully analyze their works, he will quickly be amazed by the simplicity and the order that prevails in the methods, the rigorous logic of the laws adopted, and the science with which those artists knew how to employ the material in presenting the lightest appearance, while erecting structures eminently stable. For it is unnecessary to conclude from this, that in those monuments the parts merely ornamental deteriorate m more or less rapidly, and that the work is not durable. The ornamentation is so combined that it can easily be replaced without weakening the structure in any way. On the contrary, that is independent and wisely conceived, is protected from deter-

deterioration. It is indeed necessary that it should be thus, so that those monuments, so light in appearance, have been a able to resist mutilations and the injuries of time, and that by the aid of some repairs of the surface, one can restore to them all their former splendor.[1]

Note 1.p.433. The two doors of the calends and of the library could thus be restored by the diocesan architects of Rouen, MM. Desmorets and Barthelemy, without too much trouble and expense.

The great doorways of our churches of the 14 th century present a system of construction and ornamentation analogous to that so well developed by the doorway of the calends. During the first two-thirds of the 15 th century were built in France few religious edifices. The misfortunes of the time and the exhaustion of resources did not permit this, and it was only under the reign of Louis XI that some works were commenced. Yet the general principles adopted for the doorways of churches were not changed, and it is only by the details of the style, that the latter works differ from those of the 14 th century. The gables assumed even more importance, the mouldings of the jambs and arches were multiplied, the statuary was stifled more and more under the profusion of the lines of the ar architecture and ornamentation; the tympanums frequently disappeared to give place to glazed openings; the lintels were curved as segmental arches; the prismatic mouldings were enlarged with great projections. At the beginning of the 16 th c century, nothing was yet changed in the principal arrangements, of these openings, as one can recognize by examining the doorways of the churches of S. Wulfrand of Abbeville and of S. Riquier; but in the two last monuments it may be shown that the doorways of the facades are so connected to them, both as architectural lines and as ornamentationand iconographic syste , that it is impossible to separate them.

The principal doorway of the abbey church of S. Riquier presents in its tympanum a tree of Jesse forming a glazed window. The idea is ingenious, but rendered with exaggerated labor in details and a poor style.

Among the doorways of the end of the 15 th century and the beginning of the 16 th, we mention those of the cathedrals of Tours, Beauvais, Troyes, Sens (north transept), Senlis (same),

the two last being very remarkable.

The north and south doorways of the church of S. Eustache of Paris likewise date from the beginning of the 16 th century, and free themselves somewhat from Gothic principles.[1] It is necessary to cite here also, as belonging to the first period of the Renaissance, the principal doorways of the church of S. Michel of Dijon, of Vethueil near Mantes,[2] Sa Nizier at Lyons, Belloy, and Villeneuve-sur-Yonne. Those doorways almost entirely retain the Gothic rules in their general arrangement; splays, arches, mullion and tympanum; the new element scarcely appears except in the execution of the details of the sculptures and in the mouldings.

Note 1.p.436. See the work of M. Colliet, Monographie de l'eglise Saint-Eustache.

Note 2.p.436. Se Archives des monuments historiques published under the auspices of the minister of the House of the emperor and of Fine Arts.

PORTES DE SECOND ORDRE, DEPENDANT D'EGLISES.

Doorways of the second order belonging to Churches.

Besides the great doorways opened at the middle of the principal and transept facades, churches possess an inferior order, opening either into the side aisles or the dependences, such as cloisters, sacristies, chapter halls, etc. Those doorways of small dimensions are sometimes quite richly decorated, or being very simple, are still impressed by a remarkable monuments, character. They are closed by one or two leaves, but are without the central mullion.

We shall place in the first line here one of those doorways of the abbey church of Vezelay, as belonging to that beautiful Romanesque architecture of the order of Cluny at the end of the 11 th and beginning of the 12 th centuries.

This doorway (Fig. 71) consists of two jambs with fluted p pilasters supporting two stilted archivolts, decorated by deeply sunk ornaments of great scale. The reliefs that decorate the lintel and tympanums represent the annunciation and the visitation. the birth of the Saviour; the angel arousing the shepherds and showing them the star; below is the adoration of the magi kings. On the capitals are sculptured two angels with extended arms; one of them sounds the trumpet; on those of the pilasters is an archer; opposite is a serpent with a

woman's head among the foliage. The angels announce the coming of the Messiah, the archer aims at the siren, the fall of the demon.

The height of the capitals and the unusual size of the ornaments give to that doorway a grand appearance of a rude severity, which produces a grand effect. The sculpture is further of very beautiful character. At A is given the plan of the d doorway; at B is the section of the archivolt; at C is the s section of one of the fluted pilasters. This door had a single leaf.

Before that epoch, i.e., during the 11 th century, the lateral or secondary doorways of churches are extremely simple. Most frequently and especially in the provinces of the Centre, they are composed of two jambs without mouldings, with a lintel reinforced at the middle of a relieving arch above (Fig. 72). In Auvergne, Nivernais, a part of Berry, upper Champagne and Lyonnais, exist some openings of this kind with a single leaf, that date in the last years of the 11 th century. Fig. 72 bis gives the section of one of those doorways, whose relieving arch forms a tunnel vault inside above the tympanum. In Burgundy the lintel forming a circular tympanum under the relieving arch is always employed, and that arch is decorated; for the Burgundian school is lavish in sculpture. At the south side of the nave of the church of Beaune is still seen a very pretty doorway of this kind and perfectly preserved. The jambs are accompanied by two little columns, and the archivolt is accompanied by a sculptured round (Fig. 73). This doorway date from about 1140. At A we give the plan, and at B the s section. This door has two leaves.

The examples just drawn already indicate that the architects of the middle ages changed the arrangement of the doorways w when they changed their scale. Thus these Romanesque doorways, independently of their dimensions, have a character entirely different from the principal doorways. The secondary doorways are not diminutives of those, and admitting that their dimensions were not indicated, they could not be confounded with the wide openings made in the facades of the great churches. There is an instruction not to be disdained; for the principal quality that every architectural member must possess is to a appear to fulfil the function for which it is intended. Still

we do not find that appearance in perfect conformity with the function in the modern monuments. Many of the secondary doorways of our edifices are only reduced copies of great doorways, possessing the same members, proportions and ornaments, diminished in scale. Certainly that is not an advance, since it is not according to reason. One can also state that on certain monuments of imperial Rome, there is neglect of these rules of good sense and good taste, when it concerns doorways, and that the openings of the second order are composed like the greater openings, without taking into account the reductions of the scale.

The three first examples of Romanesque doorways just given belong to the schools of Burgundy and of the Centre. Those of Vezelay and of Beaune are distinguished by the strength of t the mouldings and the breadth of the ornamentation, because these openings depend on edifices, whose members have a power, that one does not find in the monuments of the other provinces. But if we penetrate into Ile-de-France, Valois and Beauvoisois, on the contrary we see that doorways of a secondary order dating from the second half of the 12 th century are distinguished by the refinement of the mouldings. Very delicate taste and the absence of exaggeration in the proportions.

Here (Fig. 74) is a doorway opening laterally on the nave o of the church of S. Remy-l'Abbaye, which is distinguished only by the beautiful arrangement of the jointing. A single moulding is very delicate and decorated by sinkings (see detail A), and surrounds the archivolt that relieves the lintel reinforced at the middle of its length. In that example is the trace of an art both sober and refined, which belonged to that province in the decline of Romanesque art. That recalls the antique structures of the best time.

If one desires to seize at a glance the variations of the French school at the end of the first half of the 12 th century, when it concerns doorways of an inferior order, it will suffice to examine Fig. 75, that gives at A a side doorway of the old church of Alet, now destroyed in part, and at B a lateral doorway of the nave of the church of Cinqueux (diocese of Beauvais). The doorway A seems copied from a Romano-Greek edifice of northern Syria; that of Cinqueux already frees itself from antique principles. The principle of construction

is identical for both examples, but the characters are different. This parallel sufficiently shows that our architecture of the 12 th century must be studied by provinces; like the dialects that have concurred in forming our language; that t this study demands a delicate analysis of the collection of a great number of materials, if one pretends to appreciate the various sources from which our art of the middle ages drew b before attaining the development of the lay French school.

We could accumulate examples suitable to emphasize the variations of the Romanesque schools of ancient Gaul in the expression of the same principle, but we fear to tire our readers by unduly extending this Article, already too long. The different provinces of the territory now called France based themselves on the same elements in the formation of their architecture as well as their language, during the 11 th and 12 th centuries. The low Latinity is the point of departure, but e each province possessed a particular character; they suffer influences, either local or foreign. then comes a moment when the royal domain acquires a marked predominance in politics a and literature as in the art of architecture. Then the arts of the provinces pass into a state of patois, so to speak, a and the art that develops within the royal domain becomes the sole one officially recognized, that which everyone hastens to imitate with more or less skill and aptitude, and that ends bystifling all others. This is the important fact in our history, that distinguished minds however have pretended to regard only as an eccentricity, an oddity or a void. But why be surprised by the existence of a prejudice, when we can state that before the labors of M. Littre on the French language, men only saw in our provinces of the middle ages only the echos of a rude and barbarous language, and that all the refined analysis of the learned was necessary to show to those, who took the trouble to read him, that this language of the 12 th century is complete, eminently logical and frequently filled with beauties of the first order. These are now acquired facts, and it seems equitable to give the name of barbarians to those among us that ignore them, when all Europe is associated in our labors, and regards our literature and our arts of the m middle ages as the awakening of intelligence in the midst of the disorders, that succeeded the fall of the Roman empire.

Let us return to our doorways. The two examples of Fig. 75, which belong to the same epoch, take different characters derived fro different schools; here i a third (Fig. 76), that differs from the two first. This doorway opens on the tomb c chapel of S. Claire at Puy-en-Velay, a pretty monument built about the middle of the 12 th century on an octagonal plan w with a little semicircular apse. Its archivolt consists of black and white voussoirs, and its tympanum presents a mosaic in two colons. The lintel is decorated by a cross with halo of four disks on a slightly hollowed front. One finds here the most delicate expression of the Romanesque art of Auvergne arrived at its climax; it is difficult to produce more effect at less cost.[1] This art of Auvergne had then attained a very high plane, both in construction, harmony of proportions and tracing of mouldings, and still it must soon efface itself under the influence of the architecture of the royal domain.

Note 1.p.443. See the entirety of the chapel of S. Claire of Puy in Architecture et les arts qui en dependent, by M. J. G Gailhaboud. Vol. 1.

In 1212 was set the first stone of the cathedral of Rheims. The work was commenced at the choir anf the two transepts; indeed at the base of the gable walls enclosing the latter, on e notes the presence of round-arched windows, that again recall the arrangements of Romanesque churches. At the north side opens into the transept at the right of the principal doorway a secondary opening that formerly entered from the cloister and is now walled up. This doorway (Fig. 77) certainly belongs by the character of the sculpture and by its composition to the reconstruction of the cathedral of 1212, and one would ra rather believe to the end of the 12 th than the first years of the 13 th century.

A porch of a little later epoch was covered by a tunnel vault and protects the doorway, which has retained all its paintings. Its decoration consists of a statue of the Virgin seated in the tympanum beneath a very rich canopy with curtains. The round-arched archivolt is ornamented by statues of angels. At the crown is the Virgin in the form of a little nude figure carried off in a veil by two angels. Two other angels of larger dimensions fill the angles; one holds a cross and the other seems to bless. The top of the pointed tympanum is covered by

a painting representing Christ in his glory, accompanied by two adoring angels. The little jambs represent in front very delicate scrolls, laterally are clerics occupied in religious functions.The sculpture is entirely covered by brilliant coloring, but the subjects covering the tympanum behind the Virgin have disappeared. Two strong corbels support the lintel. (See section 7).

Examining this Fig., one recognizes that the Champagne architects of the beginning of the 13 th century sought new combinations, or at least that they knew how to profit by Romanesque traditions to apply them in an original fashion.[1] The sculpture of figures and ornaments of this doorway are very good, and are still uninjured by the style of the 12 th century, as if it had been **entrusted to** some old master. This fact sometimes appears at the beginning of the 13 th century. There was then evidently a young school tending to naturalism, and an archaic school in its decline; but we shall have occasion to state the influence and the antagonism of those two schools in Art. Statuaire.

Note 1.p.445. See the details of this doorway in Architecture et les art qui en dependent, by M. J. Gailhabaud. Vol.II.

The cathedral of Amiens was commenced in 1220, several years after that of Rheims. The primary constructions comprised the nave and the two transepts, and it is probable that Robert of Luzarches, the architect of this beautiful monument, could e erect only the substructures of his project. One can easily r recognize the parts of the edifice over the construction of which he presided. These are the buttresses and piers of the nave up to the height of the capitals of the side aisles, the lower parts of the great western doorway, and the base of the south gable wall of the transept. In the primitive plan, the nave comprised no chapels; beautiful windows directly lighted the side aisles;[2] but under the first window of the nave at t the south and near the western facade, opened a secondary doorway into the cloister, established at that side. This doorway is now masked by a porch of the 14 th century, and nowise recalls by its style the lateral doorway of the cathedral of Rheims that we have given (Fig. 77). Because between the architecture of Champagne and that of Picardy the differences are notable at the beginning of the 13 th century, and still the

architects of those monuments both came from the royal domain; but it is evident (if not to their praise) that the masters knew how to lend their talent to local traditions, to the quality of the materials placed at their command, and to the genius of the people that called them. The lateral doorway of t the nave of Notre Dame of Amiens still in the details of the sculpture is somewhat impressed by the style of the 12 th century, but the composition is entirely new. First it is accompanied by two blind arches comprised between the buttresses; the three arches (the central one being almost round) are surmounted by gables represented by a simple bevel; its entirety is wide and low; statuary is excluded froc it. In fact,as the Gothic architecture of Champagne is at its origin lavish with sculpture, so as that of Picardy sparing of it. But on the c contrary, the sculpture of ornament is rich and broadly developed; the capitals of that doorway are beautiful (Fig. 73); the abacuses and even the astragals are decorated; the tympanum is covered by diaper work and rosettes with great character. The arches are already accompanied by cusps and the mouldings are fine and multiplied. One finds in that secondary c composition the amplitude, which is one of the most beautiful qualities of the cathedral of Amiens. There are no longer the massive and elongated proportions of the cathedral of Rheims; the supports are slender and the openings are wider. Thus the artists knew how to put variety in their works and to adopt a system, followed faithfully in all the details as well as in the entireties of their compositions. At A is traced the plan of the lateral doorway of the cathedral of Amiens; at B at 1 : 20 of full siqe is the section of a jamb with its monolithic column, the abacuses of the capitaly and the trace of the archivolts on these abacuses, the mouldings a and b forming the cusps; the face of the tympanum being at c. At C is given at the same scale a fragment of diaper work that decorates the lintel-tympanum.

Note 2.p.445. Art. cathedrale, Figs. 19,20.

About the same epoch was rebuilt the cathedral of Chartres on its earlier foundations. At the feet of the two western b buttresses of the transepts, the architect of the beginning of the 13 th century placed two doorways intended to give entrance to the crypt. These doorways are extremely simple and

only recommend themselves by the beauty of their construction. We give one of them (Fig. 79). A large splay cuts off the jambs and archivolt externally; the lintel-tympanum is supported by two corbels, and is pierced by an opening intended to light the crypt. At A is traced the section of that doorway. Here again can one seize the harmony distributed in the edifices of the beginning of the 13 th century. By its character alone, this architectural member distinguishes doorways belonging to religious monuments from a more robust appearance. The principle of construction is always the same; but the rudeness of the forms of Notre Dame of Chartres makes itself felt in t this detail. Opened in the side of Notre Dame of Paris or of Notre Dame of Rheims, this doorway would make a blemish, while it is in its place here and does not contrast with all that is around it. To see by itself one of these doorways, one can then say not only to what epoch, but also to what monument it belongs. Could one classify in a manner as certain the different members of our monuments? Is this unity, so necessary in every work of art observed as a rule in our days?

If we abandon this primitive Gothic art, and if we penetrate into its derivatives about the second half of the 13 th century, we can still find many examples of doorways to collect.

We have seen that certain provinces like Poitou, Saintonge and Limousin, in the Romanesque epoch had adopted doorways with neither lintels nor tympanums; that tradition was retained during the Gothic period in the same provinces and in the countries subje t to the influences of those schools. This we see at the abbey of Beaulieu, a church of the second half of the 13 th century, whose doorways are still without lintels a and tympanums, like that of the Souterraine that we have drawn. (Fig. 61). One of the secondary doorways of the church of Beaulieu is also noted for the beautiful and broad arrangement of its archivolt and the purity of its proportions (Fig. 80). The section A of this doorway shows that the archivolt with great voussoirs is turned only in part, and that the leaves open u under a rear vault a, formed by a segmental arch. The moulding b of the archivolt is intended to connect the facing voussoirs to the costruction. This moulding is then not merely an ornament, it is a necessity of construction utilized by the architect. In fact, it i necessary to consider those projecting

mouldings that sometimes circumscribe the voussoirs of the archivolts of doorways during the 12 th and 13 th centuries, as a means of avoiding ruptures. The arches often having only a small thickness, like the facings over them, it was useful to bond these stone facings to the structure; the projecting moulding of the archivolt fulfilled that office, like the courses of the abacuses for the capitals. This system was the more necessary here, because of leaves having to open to the crown of the pointed arch, opened beneath the rear vault, that could not be concentric with the front arch. Constructors never cut that rear vault in the upper voussoirs, for they carefully a avoided defective masonry. Then the made two abutting arches; that of the head covering the opening at the front, and that of the internal recess forming the rear vault; then the external moulding bonded together these two arches by making them solid. In the construction of the doorways, such as those of churches, opened under thick and high walls, the architects took good care to avoid ruptures by cutting the extradoses of the arches and not bonding them to the facing. So that these arches under a considerable pressure should not tend to leave their planes, they were frequently set with a row of voussoirs of little thickness, but with strong tails.

By analyzing thus the members of this architecture that seem purely decorative, one recognizes the common and practical sense of the architects of the middle ages. There is not a f form for which one cannot render a reason, not a detail which is not justified by a necessity of the construction. Those a architects can thus teach us something, were it only to reason a little when we build. Then how should we be surprised if certain modern schools, that the custom of reasoning generates in the use of unjustifiable forms which they extol, pretend that this art of the middle ages is barbarous, and that its study is only good for corrupting the taste, only to stifle what they desire to regard as sane principles?

For those schools the art of architecture seems to be only an affair of faith, and they would say frankly like S. Augustine:- "I believe because I do not understand." We should say more frankly concerning architecture:- "Do not believe unless you understand." But to comprehend, it is necessary to analyze, reason, collect and compare; this is sometimes a long and pa-

painful labor; rather than devote themselves to this, men prefer in certain cases to condemn without seeing, judge without knowing, and continue to pile up materials in excess, without economy and without reason.

If in the largest doorways, as in those of moderate dimensions, that we have presented to our readers in the course of this Article, one computes the volume of materials employed to resist the enormous loads, he will find that this volume is very small compared to the pressures received; that is to be considered.

Conditions are sometimes presented, such that the architects could avoid round or pointed relieving arches forming the covering of an opening, but dared not trust to a simple lintel, for example when doorways open in a wall of small thickness and of moderate elevation; they they content themselves with a circular arch forming the hea , or they design a depressed arch. There exists a pretty doorway established under those conditions and opening in the wall of the old sacristy of the cathedral of Clermont.[1] That doorway dates from the last years of the 13 th century; its arch is a depressed pointed (Tudor) arch (Fig. 31), whose centres are placed at a and b. Its profile drawn at A at 1 : 10 full size is decorated by two h hollows sculptured with much delicacy in lava from Volvic. Th The base of the jamb as detailed at A is very happily composed. This doorway is internal; (that should not be forgotten); it opens on the side aisle of the choir, and in fact it takes t the forms in general and details that suit that place. One rarely notes in France this form of depressed pointed arches. However this example tends to prove how the artists of that time retained complete independence in the use of forms, that they believed they should adopt, however little they subjected themselves to routine.

Note 1.451. This sacristy is arranged in the square chapels of the choir of that church at the southern side. (Art. Cathedrale, Fig. 16).

In speaking of the principal doorways of churches, we have stated that particularly in the province of Champagne, one n notes a great number of doorways whose tympanums are windows. Thus are composed the western doorways of the cathedral of R Rheims. One likewise sees in that province secondary doorways

of churches with lintels surmounted by an actual window forming an entirety with the door below. The church S. Urbain of Troyes again supplies us with an example of this sort of openings into the two side aisles.[1] Those doorways were preceded by a porch that was not finished. Fig. 32 gives one of these; a great glazed window surmounts the lintel; the pointed arch of that window serves as side arch of the vault of the porch, whose sides rest on the two little columns A. (See section B). The jambs of the doorway, lintel, tracery and arches of the window are built of lias from Tonnerre, while the facings are constructed of low courses of stone from Bassancour, quite c coarse in appearance but strong. At C we give the section of the jamb made on a b.

Note 1.p.452. See plan of the church S. Urbain in Art. construction, Fig. 102.

In the composition of these doorways of churches surmounted by windows, the architects of Champagne seem to have not only desired to pierce openings wherever practicable, but especially to decorate internally the tympanums of doorways, whose n nudity behind the reliefs contrasts with the external richness. If this only concerned the secondary doorways, this was a means of lighting the vaults of side aisles under the towers of facades, of obtaining an effect analogous to that produced by the great windows with roses pierced over the principal doorways of the high naves.

For example, at the cathedral of Chartres, the doorways of the transepts at north and south are marvellously sculptured on the exterior; their tympanums, arches and jambs, are covered by statues, reliefs and ornaments; but in the interior they present at the base of the gable walls only plain surfaces s scarcely relieved by bands indicating the arches; these are only backs that seem to await decoration. Perhaps the architects of these grand edifices must have ornamented these backs by lobbies of joinery and by paintings, but no trace remains of those arrangements today. That leads us to suppose that l lobbies and joinery must have been attached to the backs of those drawings is that frequently the jambs or mullions show projections like unfinished pilasters. In Champagne lobbies must certainly enclose these internal splays of the grand and medium doorways of churches. The depth of those splays is cal-

calculated to allow the leaves to open without reaching the internal face, suffices to demonstrate this, even if the plan of the church of S. Nicaise of Rheims did not prove in the m most positive manner, that the doorways of the facade and transepts were finished with lobbies. (Art. Porche, Fig. 29). Then the glazed windows over the doors (as at the cathedral of Rheims) lighted the interior over these lobbies and contributed to the general decoration. The architect of the western facade of that cathedral even did more, for he occupied all internal surfaces beside and above the doorways by stories placed in superposed niches.

The lobbies projecting from the surface, it was therefore conceived, that the back of the facade inside was worthy of the exterior. In Ile-de-France, Picardy, and in general in all the churches of the middle ages of the period called Gothic, one should note that the experiments, or at least the lack of completion in the composition of these backs of the principal and medium doorways. We say lack of composition, because in f fact aside from traces of attempts that frequently remain, o one sees several secondary doorways with backs vere skilfully composed. On the southern side of the choir of Notre Dame of Paris exists a little doorway, that formerly opened into the cloister. That exit was known under the name of Red doorway, and is a masterpiece of the second half of the 13 th century.[1] Its sculpture and the mouldings are in unimpeachable taste. Now in the interior this doorway presents sober and well intended decoration, evidently arranged to receive a lobby of joinery. Opening at the back of a chapel, it is surmounted by a window, partly masked by its gable.

Note 1.p.454. By its style this doorway evidently belongs to the rebuilding of 1257; although most of the guide books, we know not on what authority, mention it as belonging to the 15 th century. The 15 th century did not set a single stone in the cathedral of Paris.

At the cathedral of Meaux the architects of the 13 th and 1 14 th centuries have also decorated very richly the backs of doorways of the transepts, by means of an entire system of little piers, arches and gables as a facing. Even at the cathedral of Paris, the back of the southern doorway is occupied by arches with gables and by two niches ornamented by canopies

and intended to receive statues. But this entire gable wall dates from 1257. It would appear that before that epoch, on the contrary the architects avoided to compose decorations in stone at the backs of great doorways. Yet already at the beginning of the 13 th century, as for example at the cathedral of Chartres, the gable walls over those great doorways were pierced by rose windows and by open galleries filled with brilliant glass; it scarcely appears probable that below a decoration as sigple and rich, that they would have desired to allow the bare walls to appear, and the backs of the wooden leaves. We shall remark that in those great churches because of the architectural system adopted, there remained nowhere a w wall surface, all being occupied by glass, piers and arches; consequently no surface for developing painted subjects. Now there is every reason to believe that those wide spaces below the rose windows and galleries, above and beside the doorways on the inside, were intended to receive paintings; no place was more favorable, and one imagines then what effect would be produced by those enormous areas, all resplendent with stained glass in their upper parts, filled by paintings in their lower parts. Let one also assume below these paintings, behind the leaves of the doorways, beautiful lobbies of joinery, and complete in thought the decorative system of those immense surfaces, whose bareness now appears inexplicable. But about the second half of the 13 th century, it seems that men r renounced the placing of painted subjects anywhere except in the windows; then the architects decorated the backs of the doorways below the gables as at Rheims, Meaux, and even at Paris.

The 14 th century did not furnish in the construction of i its religious monuments new arrangements for doorways of the second order; the vagaries of the end of the 13 th century a are followed, and the examples that we could present would d differ only by some details from those already given. As for the 15 th century, it bagan to construct churches only toward its last years; and if the doorways of the civil edifices of that epoch have a very decidedly original character, those b belonging to religious monuments are only noted for the skill of draftsmen and the delicacy of the sculpture. For the general arrangement, they return to the examples last given here. (Arts. Trumeau, Tympan).

PORTES D'EDIFICES CIVILS, EXTERIEURS ET INTERIEURS.

External and Internal Doorways of Civil Edifices.

In the cities of the middle ages, the castles and the palaces alone possessed carriage gateways, and those entrances w were laboriously fortified. As for the doorways proper of houses, if those habitations were provided with courts, there we were only what we term alley doorways, i.e., arranged only for persons on foot, with a width of 3.3 to 4.9 ft. and a height at most of 8.2 to 9.8 ft.

We know no doorways of civil edifices belonging to the 11 th century in France, that present any special character. Entrance openings are further very rare from that epoch, and consist only of two jambs with a round arch of small masonry, and do not differ from the little church doorways, that one still sees opened in the sides of some religious monuments of Beauvoisois, Berry, Touraine and Poitou.

It is only at the commencement of the 12 th century that o one can assign a civil character of the doorways of houses, a and it is still in the city of Vezelay within that old commune, that we find examples of those entrances of the houses of citizens. Among those houses some possess a first story over a ground story, and sometimes a square tower. The external facade was pierced by rare and quite narrow windows, the light in the apartments being received from a little internal garden. From the street to the garden one passed through a tolerably spacious vestibule and by a relatively wide round-arched doorway. Fig. 33 gives the external elevation of one of those doorways at A, its section at B. At C we have sketched at 1 : 5 full size the sections of the two archivolts. One will note that this opening (that further is repeated several times on facades of houses of the 12 th century at Vezelay with some modifications in the details) nowise recalls the style of the religious architecture of the abbeys. This doorway has a civil character, rather approaching those Romano-Greek edifices of Syria previously mentioned. Inside is erected a rear arch D, that alone allows opening the leaves. Those doorways of h houses of the 12 th century are sometimes accompanied laterally by a square window, a sort of wicket pierced at the height of a man inside, which allowed an examination of the persons that knocked; or also a window above the archivolt, the ligh-

lighted the vestibule.[1] Soon were abandoned however these round arched doorways for entrances of habitations, or at least stone lintels with tympanums were plaaed under these arches, that remained as relieving arches. Thus are conceived the doorways of the houses of the cities of Cluny and of Provins built about the end of the 12 th and the beginning of the 13 th centuries. Frequently even the relieving arch disappeared entirely on t the exterior and only forms a rear arch inside. The wooden l leaves fitted the round-arched form very badly; it was simpler to give these leaves a rectangular form, particularly when c composed of a single leaf. The semicircle was then abandoned for these doorways, being replaced by the rectangular opening. If the archivolt remained, it only relieved the lintel, so as to prevent it from breaking under the load. Then rarely in c civil architecture the tympanum is decorated by sculptures. One still sees in the buildings formerly dependant on the abbey of S. Vane, now enclosed in the citadel of Verdun, a doorway of that kind, whose composition is original, and which dates from the firs years of the 13 th century.

Note 1.p.Art. Maison, and the work on Architecture civile, by Mm. Verdier et Cattois.

This doorway (Fig. 34) is composed of an archivolt with doubled voussoirs resting on decorated jambs, at each side being two little monolithic columns, as indicated at A in the horizontal section of one of these jambs. The archivolt forms a relieving arch and an internal arch at B (see section). Corbels relieve the lintel-tympanum ornamented by foliage. But so sometimes those external doorways of houses were furnished w with permanent hoods of stone or wood, to allow persons knocking at the door shelter while one came to open to them. There still existed a few years since a doorway of the 13 th century so designed, as the facade of a little house of Chartres.

This entrance (Fig. 35) has a width unusual for an alley do doorway, and was flanked by two projecting jambs like reveals, bearing two corbels on which rested a stone gable, forming a strong projection over the street. An archivolt B flush with the wall (see section A) served as a relieving arch over the tympanum, and was pierced by a little window designed to light the vestibule when the leaves were shut.[1] The gable-hood consisted of simple slabs extending into the surface of the wall.

Because of the width of the opening the lintel was replaced by a segmental a ch wit internal rebate to receive the two leaves. We give at C at double size the section of one pier. It seemed that this sort of entrance was habitually employed in this province, for the church of Blanc still possesses a doorway constructed according to the same arrangement, but without a lintel.

Note 1.p.459. This house has since been destroyed; we were only able to find its site during a last journey in the department of Indre.

The corbel, the impost of the segmental arch, and the penetration of the archivolt, were cut in the same stone. The impost of this archivolt is likewise solid with the corbel course G. But the materials at command did not always permit making stone projections of a nature to resist storms. Without changing the programme, the architects of the middle ages, sometimes established wooden hoods above the doorways of houses. Fig. 186 gives us an example of these entrances of houses. We have assumed the hood to be removed at one side, so as to show bettes how it was placed.[2] At B we have sketched the section of this doorway with the rafters of the hood, and at C the section of one of the jakbs at double size. This doorway dates from the second half of the 13 th century; it was closed by a single leaf.

Note 2.p.459. This doorway comes from a house of Chateau=Vilain.

If there be a great variety in the forms of doorways at that epoch, i.e., during the 13 th century, civil architecture presents a no less great number of original arrangements, and yet we no longer possess in France but a few houses built from 1180 to 1300.

Further, during tha period, it was a quite frequent custom, especially in the provinces south of the Loire, to build houses with porticos. Then on the public street the doorway was merely a simple arch or rectangular opening composed of two jambs and a lintel. Also frequently the ground stories of city houses were occupied by shops, whose fronts opened under arches:-[3] one of those arches served for entrance to the stairs communicating with the upper stories. The closure consisted of a frame with leaves. During the 14 th century the doorways of houses are generally simple, and are very rarely dec-

decorated by sculptures; they only consist of a pointed archivolt flush with the wall with lintel beneath, or of a rectangular opening with stopped chamfers on the angles. Yet already about the end of that century appeared the arch cut in the lintel. On the contrary, the doorways of palaces built during t this perio are of great richness. Those of the palace at Paris, and which exist in some remains and doorways, were very beautiful. (Art. Perron). Those of the stairway of the Louvre, built by Charles 7, were likewise very ornate.

Note 3.p.459. Art. Maison, and the work already cited by MM. Verdier & Cattois.

The 15 th century, during which were built few churches, saw arrive a number of castles, palaces and houses, whose external doorways were decorated by sculptures, figures and arms. Among those palace doorways of the 15 th century we should p place in the first line that of the mansion of Jacques Coeur at Bourges, still nearly intact today. It was in 1443 that the celebrated treasurer of Charles VII commenced the construction of this beautiful residence. Arrested in 1451 at Taillebourg on the order of the king by Olivier Coetivi, Jacques Coeur c could scarcely enjoy the mansion, that he had built in his n native city. The portal of that mansion (Fig. 37) is opened b beneath a rectangular loggia occupying nearly the middle of the facade on the street. It consists of a carriage gateway with a postern at the left side. The carved wooden leaves of the great opening are also pierced by a very narrow wicket s surmounted by a knocker, and open in rectangular form within the pointed arch under a vaulted portal with segmental vault. Above the doorway is formed a recess, partly at the expense of the wall, partly corbelled, that recess being covered by a very open canopy supported by two delicate piers; it contained an equestrian statue of king Charles VII.[1] A wide window with tracery opens on that recess and lights the chapel in the second story. At the sides of the recess are inscribed two complete windows, that on the right opening at the side with the entrance of the kitchens, having the figure of a woman, and that on the left on the side next the city, having a figure of a man. Those two statues are visible only as busts above the balustrade, appear to look outside and seek what occurs on the public street. Thus as M. Vallet de Viriville said in

the curious note on Jacques Coeur, that he recently published;[2] "Those two figures seem to represent Vigilance. On the front appears the public and respectful homage rendered to the sovereign authority by the officer of the king, but at the same time and under the same protector, the personality and individuality of Jacques Coeur is displayed with remarkable assurance and freedom." Indeed, on this portal as on all other parts of the edifice appear hearts, pilgrim's shells and the motto:- "Nothing is impossible to valiant hearts."

Note 1.p.462. The same arrangement is found at the entrance of the chateau of Blois and over the doorway of the city hall of Compeigne.

Note 2.p.462. See Jacques Coeur, by M. Vallet de Viriville. Paris. 1864.

One will note that the idea of symmetry nowise entered into the composition of this portal, and yet the voids and the solids, the plain and decorated parts balance in an entirely happy fashion, without the eye being offended by this shifting of the axes. There were required a carriage way and a postern, and the architect has opened them between two walls that form the pavilion. He took the axis of the latter for opening the window lighting the chapel, and he has combined the recess w with that window to form a great upper arrangement, indicating a high and vaulted story. The windows filled by the two figures fall under the angles of the pavilion; but tthose windows are solid, and the architect took care to assume a partial o opening of the leaf of each of them, that strengthens their piers under the angles of the pavilion.

We shall cite the entrance doorways of the mansions of Sens and of Cluny at Paris, that still exist and are several years later than that.[3] In Art. Maison we have presented some drawings of the 14 th and 15 th ce turies,[4] that will dispense w with entering into more details of this important part of the habitations of the middle ages. Still we shall say some words on the external doorways of stairways, which present a particular arrangement. We further indicate [1] how the stairs of habitations of the middle ages were nearly always built as screw stairs. This system required the opening of quite low doorways, since it was necessary for the lintel to conceal the first re revolution of the steps. But then this lintel was often regar-

regarded as an impost surmounted by a window lighting the second revolution. We find again in the mansion of Jacques Coeur at Bourges a complete example of this sort of doorway. (Fig. 33). The lintel forms an impost and presents an interesting sculpture. Three trees are detached from the background. That in the middle represents an orange, the one on the right is a date, and that on the left is a sort of mimosa. Between these trees grow exotic plants, among which is a carnation. It i known that Jacques Coeur made several journeys to the Orient, and that he carried on an extensive commerce with those countries. These plants seem to be emblems of those relations, and perhaps to the illustrious treasurer, we owe the introduction into France of some of our medicinal and garden plants. Around that relief is read the device, repeated several times in the mansion:- "To hear, -- speak, -- act, -- be silent." the letters being separated by branches of plants.

Note 3.p.482. Art. Maison, Fig. 39.

Note 4.p.482. See Figs. 21, 24, 25, 27, 28, 29, 37. Also A Art. Salle.

The first revolution of the stairs passes behind that lintel and is lighted by the window at the height of the impost.[2]

Note 1.p.483. Arts. Chateau, Escalier, Maison.

Note 2.p.483. See Notices sur les monuments du Berry, by M. Hoze. 1834.

The internal doorways of palaces and houses, i.e., those openning from one room into another, are generally very simple, low and narrow,before the end of the 15 th century. They are only openings allowing a single person to pass out at a time. These doorways were further equipped with portieres. In no h habitation of the middle ages, even if princely, did one find those doors of apartments 9.8 or 13.1 ft. in height, as in o our modern mansions, for the very natural reason that however noble they were, the persons passing through those doorways did not have heights reaching 6.0 ft. If those doors are sometimes wide to allow easy passage, they do not exceed 3.2 ft. below the lintel.

Only under the reign of Louis XIV did men commence to open doorways of greater height; that was then regarded as more n noble, if not more sensible.

The internal doorways of habitations of the middle ages are

very simple, because they open behind tapestries, and one scarcely perceives more than the jambs and lintel. Their leaves alone were wrought with care. The lintels are either straight or a part are a corcular or segmental arch. One already sees in the buildings of the beginning of the 14 th century appear those lintels drawn with three centres; but particularly about the end of the 15 th century their use is freouent. During the 13 th and 14 th centuries those lintels are freouently relieved by corbels arranged in the thickness of the facings. Then (Fig. 89) a chamfer or moulding extends around the opening at the side opposite the rebate of the leaf, for it is very rare for those doors to have two leaves.

About the end of the 14 th century corbels relieving lintels are no longer employed for the doorways of apartments. Those are rectangular and are sometimes ornamented by a round forming a little column with capital and base (Fig. 90). Thus are constructed the doorways of rooms of the castle of Pierrefonds. Above the lintel is arranged the keystone of a relieving arch, and on the side of the rebate is made an arch; or if the doorways are narrow, a ceiling of a single piece of stone. The r round that decorates the facing, the capital and base are also cut in the square angles of the jambs and do not project from the face of the wall.

In habitations decorated with luxury, the lintels were surmounted by joinery over the doorway, for we have frequently found the existence of fastenings on these lintels and on the surfaces above them. If our modern mansions were ever abandoned, pillaged and ruined, one would be embarrassed to state w what composed the ornamentation of our doorways of apartments, for after all then are merely rectangular ofenings in a wall, the opening covered by woodwork, stucco and painting. Without giving such an important part to borrowed ornamentation, however the architects of the middle ages occupied themselves only with the enclosure of the front that remained visible, the w wainscot, soffits of the doorways and the tapestries did the rest, stone did not absolutely appear except on the front of that moulding enclosing it. That simplicity of the openings of internal doorways was concealed under the richness of the woodwork and hangings that contributed to the decoration of the rooms, for it is unnecessary to believe, that our ancest-

ancestors dwelt within naked walls,[1] like those seen in the r ruins of our castles. Many doorways of apartments were further equipped with lobbies or closets, that rose only to a height of 6 to 7 ft., and prevented the external air from entering the room when a door was opened. Men did not then possess hot air furnaces, and if a door were opened, a very disagreeable volume of cold air was introduced into warmed rooms. Those lobbies and portieres were intended to avoid that inconvenience. One knows how men froze in the apartments of Versailles, due to those noble doorways, that each time that the door was opened admitted some 700 cu. ft. of icy air into the rooms w with a fire, and how Madame de Maintenon, who feared drafts, found no other remedy against that perpetual draft, than to place her armchair in what duke S. Simon called a cask.

The doors of the rooms of the middle ages, and until the r reign of Louis XIV, are then low and narrow, and if one may so speak, are merely valves well furnished with clappers to prevent currents of air. It is necessary to take their part. Those doors were only enlarged when they served for communication between great halls intended to offer a series of rooms suitable for giving festivals, or for receiving a great assemblage of people, but they always retain a height varying from 6.6 to 8.2 ft. at most.

Perhaps one would take an idea of the manner in which those doors of rooms were decorated in castles or palaces. To render intelligible what we have just said on this subject, that we have combined in Fig. 91 the information collected, both on civil edifices of the end of the 14 th or the beginning of the 15 th centuries, and in vignettes of manuscripts, paintings and reliefs. One sees that the drawing properly so called, the opening in stone, is scarcely visible; the jambs and the soffit are alone visible. Above it is fixed a great work of painted joinery, that accords with the moulded supports of the tapestries. Those tapestries stop at the lower wainscot, that generally covered the base of the walls. The part of the wall l left bare between the ceiling and the tapestries was decorated by painting, and a portiere was suspended from the woodwork over the doorway.

It occurred that certain doors of apartments were entirely covered by the tapestry, that that was only divided to allow

the occupants to pass. **These were** true doors under hangings.

The examples of doorways of apartments of the end of the 15 th century are not lacking, and one can find them everywhere; they are generally covered by a segmental arch, and sometimes that arch is crowned by a recurved portion (keel arch). Pretty doorways of that kind are still seen at the palace of the dukes of Burgundy at Dijon, mansion of Cluny at Paris, archbishop's palace of Evreux, palace of justice at Rouen, and in many chateaus of that epoch, such as those of Amboise, Blois, etc.

The epoch of the Renaissance erected very beautiful external and internal doorways in the residences of nobles or in houses; but the extent of this Article will not allow us to pass the limit of the Gothic era. If we desired to select among the b beautiful examples of doorways of the beginning of the Renaissance, we should be carried much too far. Besides, those examples are reproduced in a great number of works placed in the hands of all our artists.

PORTIQUE. Portico.

This word was only introduced in the language of architects after the 16 th century. But if the word did not exist during the middle ages in French, they possessed the arrangement. W wen said porch, if the portico was small and presented itself before the entrance of an edifice; cloister, if it surrounded a court; piers if it extended before the facades of palaces a and houses on the public street or a yard. Gregory of Tours speaks of porticos of wood painted in bright colors, that surrounded the courts of the Merovingian palaces. Eginhard [1] reports that the emperor Louis the Good-natured passing over a wooden portico on Thursday of holy week in returning from the church, that wormeaten structure fell, carrying down in its fall himh with his suite. The vignettes of manuscripts of the 9 th and 10 th centuries quite frequently show porticos composed of columns with arches closed by draperies; they are seen represented on the tapestry of Bayeux. Yet it does not appear that during the middle ages, as during Greek and Roman antiquity, were erected porticos only designed to serve as walks a and shelters for the inhabitants of a city. They always formed a part of an edifice, extending beneath the house on the p public street,[1] or opened on the courts of monastic establish-

establisnments or palaces.[2] What distinguishes the portico from the cloister properly so called, is that the first is a covered gallery presenting a single front, while the cloister entirely surrounds a court by means of four porticos serving the buildings placed around a square. As for the arrangements in detail of those porticos, they recall those adopted for cloisters. They are simple piers bearing a shed roor or a girder, then supporting upper stories, and having a ceiled or vaulted ceiling. Thus the episcopal palace of Laon beside the cathedral presents a beautiful portico of the beginning of the 13 th century, composed of cylindrical piers supporting pointed arches with a wooden ceiling.[3] Unfortunately the arches of that portico were rebuilt in the 14 th century; a single arch remains intact, forming the end of the portico on the western s side; we present it here (Fig. 1). There existed at the palace of Paris beautiful vaulted porticos opening on three sides of a yard and thus forming a sort of cloister.[4] Before the erection of the existing city hall of Paris, the citizens of the city assembled in houses located on Place de Greve, and designated by the name of houses with piers, because they left in the ground story on the public street, a portico composed of stone piers supporting girders with upper stories. Men also spoke of the pillars of the markets of Paris, to designate the porticos arranged on the houses surrounding the market place, and which served as a shelter for purchasers. Many cities of the middle ages had their houses built over porticos;[5] but t those never presented a uniform architecture, each man arranging his portico as seemed good to him; which gave to those covered alleys a more picturesque appearance. There was still seen at Luxeil a few years since a street entirely opened on this system, original in appearance and pleasing by variety.

Note 1.p.468. Louis the Good-natured. 817.

Note 1.p.469. Art. Maison.

Note 2.p.469. Art. Cloitre.

Note 3.p.469. For this entire portico, see Architecture civile et domestique of MM. Verdier and Cattois. Vol. II. p. 198.

Note 4.p.469. Art. Palais, Fig. 2. There remain only some parts of this portico.

Note 5.p.469. Art. Maison.

During the middle ages mansions often possessed internal p

internal porticos, that served to shelterpersons awaiting introducti introduction into the apartments, under which the servants r remained, and where horses were sometimes fastened during the visits of the masters. Those porticos were only a gallery bef-ore the wall; for in our climate, portocos entirely open were not established, as practised in Italy. Air currents must be prevented. Those porticos of our old mansions are deep, relatively to their height and are closed at the ends.

The Mansion de la Tremoille at Paris S a mansion of which now remain only some fragments deposited at the Ecole des Beaux Arts) containing a charming portico attached to the facade on Rue de Bourdonnais. This portico was vaulted and constructed with extraordinary boldness.[1] Exposed to the Southwest, it was closed at the ends and surmounted by a gallery. From the carriage doorway opening on the street one could penetrate d directly under the portico; it was first necessary to enter the court. That arrangement, which we saw adopted several years earlier in the Mansion of Jacques Coeur, was good in that it allowed persons walking under the portico not to be interrupted by arrivals or departures, and not to be inconvenienced by the currents of air so common in our pretended classical porticos. Lords and citizens of the middle ages did not think a cold worth a monumental arrangement imitated from the Greeks or Romans. For them the portico was a gallery open on one side, deep and relatively low, closed at least at one end, sometimes returned to benefit by a more favorable exposure. Thus at the castle of Pierrefonds, along the great hall existed a low portico, a mezzanine and closed at the ends, exposed to the east, and thus being in all seasons a covered walk well sheltered from bad winds, perfectly dry and sanitary, glazed in t the mezzanine, and furnishing for the entire length of the g great hall in the ground story an enclosed balcony opening into that hall. Thus in the residences of the epoch of the Renaissance we still see porticos closed at the ends and perfectly orientated. Such were the porticos of the chateau of Madrid, in the Bois de Boulogne;[1] such are still standing, the porticos of the chateaus of Chambord and Blois, and of some houses of Orleans.[2] These tend to prove that our ancestors feared c colds, and thought that a covered walk must be a shelter for the walkers.

Note 1.p.470. See Architecture civile et domestique of MM. Verdier et Cattois. Vol. II.

Note 1.p.471. See plan and elevation of chateau of Madrid in Vol. I of Entretiens sur l'Architecture.

Note 2.p.471. Among others, that of Agnes Sorel.

POT. Pot. Vase.

The architects of the middle ages sometimes placed acoustic pots of terra cotta in the surfaces of the walls inside religious edifices, probably to increase the sonority of the interior. We have frequently proved the existence of those pots in the choirs of the 12 th and 13 th centuries. Several archaeologists have made the same observations. These pots are g generally set in the masonry, only permitting to be seen the interior of their orifices in the face of the wall. They are placed at different heights and sometimes in quincunx form, but particularly near the corners. They exist in the square apse of the church of Monreale, in the church of S. Laurent in Caux, at the abbey of Montevilliers, in the churches of C Contremoulins near Fecamp, and of Perruel near Periers-sur-Andelle. Normandy is perhaps the province in which this acoustic pottery has been most frequently employed to give sonority to choirs, but one also finds it in some monuments of Provence, and notably in the church of S. Blaise at Arles. In a Notice sur le couvent des Celestins de Metz, M. Bouteiller, member of the imperial Academy of Metz, cites a very curious passage of a chronicle of that monastery, written about the end of the 1 15 th century, in which is a mention of this acoustic pottery. In the year 1432, page 133 of the manuscript one reads:--

"In this year aforesaid, on the vigil of the assumption of Our Lady in the month of August, after brother Ode le Roy, prior of the same, had from the chapter above, he ordered t to place pots in the choir of the said church, because he had seen them elsewhere in some churches, and thinking that it w would resound more strongly there. And there were placed in o one day so many as sufficed. But I do not know if they sung better than before. And it is to be believed, that the walls were much weakened by them, and many persons that came within marvelled much that it should be so. And they said once that it would be better to take them away and play for the pleasure

of fools."

Note 1.p.472. See Annales archaeologiques. Vol. XXII, p. 294, the article by M. Didron on acoustic pottery.

Efficient or not, it is certain that this method of sonority was accepted during the middle ages. Also sometimes, notably in the church of Montreal cited above, acoustic pots were embedded in the spandrels of vaults, the orifices of the pots b being turned toward the interior.

M. Mandelgreen, a Swedish archaeologist, who has published a very curious work on Scandinavian monuments of the middle ages, stated that in most of the churches drawn by him, a great number of these pots were embedded in the walls and vaults, both in Sweden and in Denmark. Is that an antique or Scandinavian tradition, since one finds a quantity of those pots in Normandy? We shall refrain from deciding the question. In Russia many churches in the Pseudo-Byzantine style likewise possess acoustic pots. Was that custom transmitted to Russia by the Greek Byzantines?

POTEAU. Post.

A wooden timber set vertically and supporting girders, beams and sometimes facades or floors.

Wooden structures, so frequently employed during the middle ages, required the use of posts to support half timber walls, floors, sheds, etc. Those posts remained visible, for the architects of the middle ages had right ideas and never covered timbers with coatings or stucco, that rapidly destroy them. Leaving them visible, they fashioned them carefully, chamfered their angles, if within reach of the hand, not to injure persons, and to prevent injury to these angles. Many of hou houses and our halls of the 15 th century still have isolated p posts, wrought with care and sometimes decorated by carving. But one can cite as a type of those pieces of carpentry the p posts that support the floor and roofs of the custom house if Constance; thus we do not hesitate to give them here as a summary of what carpentry har done as most complete and best understood of that kind. The custom house of Constance was erected in 1388. It consists of a ground story and a second story covered by an enormous roof. The floor and roof are supported in the enterior by two rows of posts arranged thus (Fig.1).

On a layer op sandstone A rises the lower post of elm, no less that 3.25 ft. square at base and cap, so that as indicated by the section B, each of those posts must have been cut from a tree 4.9 ft. diameter, free from sap. The head of the post is cut forked and receives the first cap C and two superposed b beams, on which rest the joists. On the head of the lower post rests a second layer of sandstone D serving as a plinth for t the second post E, which bears the carpentry of a second floor under the roof. The upper post is lighter than the lower one, but is also cut with a form, and receives a cap and two superposed beams. Fig. 2 gives at A in cross section the upper post with its cap and its beams at B, these being assumed to be re removed at C, and the fork of the head being then visible. At D is a perspective sketch of that assemblage of carpentry; at E is the cap detached, with its thinner part F entering the fork of the head. At G is sketched the lower stop of the chamfer with the moulding, at I the semicircular panels of the base.and cap. Those upper posts as well as all the caps, girders and joists are of fir and are framed with the greatest c care. But what is surprising in this work is the fine quality of the timbers and their perfect preservation. That timbers of such great dimensions can suffer the variations of temperature without cracking, it was necessary for them to be deprived of their sap by some means, and stored for a very long time before their use. The same observation can be applied to the posts of our houses and halls for four hundred years. It is very rare to find a crack in those timbers.

Note 1.p.475. Arts. Charpente, Maison, Pan de bois.

One understands by a corner post a vertical timber, that fo forms the angle of two timber frames at a right angle, and i into which are framed the girts. Corner posts should be made of a single timber, so far as possible, so as to offer perfect rigidity. The timber A, Fig. 3, is a corner post. Rests and m mortises receive the ends of the girts of the floors. These c corner posts are generally fashioned from the most beautiful and soundest timbers. We have shown several of these pieces of carpentry in Arts. Maison and Pan de Bois; thus it seems useless to extend further on their function and form. Well wrought corner posts are still seen on some houses of Rouen, Chartres, Beauvais, Rheims, Orleans and Sens. There still exists

one representing a tree of Jesse at the corner of a house of Rue S. Denis at Paris, which dates from the beginning of the 16 th century. Sometimes, particularly in the castles of the 13 th and 14 th centuries, the joists of the floors do not r rest in the walls but on heavy beams supported at distances b by posts set against the internal surfaces of these walls. Th This was a means of avoiding decay, that too frequently showed itself in the ends of joists entering masonry, and permitted the erection of those walls without the care for anchoring the joists. Thus the building was covered and the floors were laid without allowing them to be wetted, which is an important poi- nt, if one desires to avoid deterioriation and cracks. The p posts set against the walls also had the advantage of allowing the attachment of the wainscot and hangings, leaving them de- tached, very favorable to their perfect preservation. Besides, if desired to inhabit these castles with walls frequently more 6.6 ft. thick, only after the masonry had dried, it would have been necessary to wait several years. The space left between the walls and woodwork or hangings allowed one to install him- self in those habitations without having to fear the dangerous effects on the health produced by the fresh masonry. Thus there were several good reasons for placing the floors on posts set against the wall, and we recommend this method to architects that build country houses, where area is not to be economized as in the great cities. The use of these posts against walls causes in many of our castles, that one perceives no trace of the floors separating the stories, although these are marked on doors and windows. Headers also frequently bore ties or br- aces to relieve the beams. The wainscot often covered these supports to the tops, and thus there become the origin of the coves of ceilings, that we see persist until during the last century. (13 th).

POTELET. Small post. Stud.

This name is habitually given to the small vertical timbers that support the sills of windows in half timber frames above th bottom sills. These timbers were often wrought during the 15 th and 16 th centuries. (Art. Maison).

POUTRE. Girder. Beam.

A timber placed horizontally and of large size, that serves to reduce the span of joists of floors. For more than 200 years, in order not to lose space in height of houses and palaces, girders have no longer employed, and the floors are constructed by means of headers, tail joists and joists, all timbers being set in one plane, so as to be able to lath and plaster the ce ceiling, but formerly and still in most French provinces, the joists are placed on beams relieved by corbels at their ends. (Art. Plafond).

PRISON. Prison. Cell. Dungeon.

Castles, abbeys, episcopal palaces, city towers and chapters, possessed prisons within their walls during the middle ages; these prisons were merely cells arranged more or less well, dungeons or even inverted cones. The middle ages did not have to erect special establishments intended for prisoners, establishments that could only exist in a state in which the exercise of justice is centralized. It is unnecessary to state t that prisons constructed in our old edifices are not marked by those careful measures, sanitary arrangements, and that well intended system of oversight, that today place these establishments in the class of complete and wisely designed edifices. Still the number and horror of these places of confinement during the middle ages have been much exaggerated. There still exist at the castle of Loches very authentic prisons, that are nothing more that grated rooms, also sanitary and s sufficiently lighted. Such are likewise seen at the abbey of Mt. S. Michel-en-Mer, also at the keep of Vincennes, and in most of our old fortresses, which differ from the chambers reserved for the inhabitants only by the scarcity of exits and the bareness of the walls. There is no need of being well versed in the history of those times, to recognize that prisons were necessary in every feudal domain, but we should state that very few of these terrible death cells (Tgo in peace") appear to have been occupied, while the cells, that were only well f fastened chambers, were often filled. It seems that what was most to be feared by the prisoners of the king or lords, were the exactions of the jailers, and we take for proof this passage from the Apparicion de maitre Jehan de Meun:--

(Old French poem.).[1]

Note 1.p.498. L'Apporicion de Jehan de Meun, published by the Society of Frech Bibliophiles. p. 35. (14 th century).

And further:-- (Old French poem).[2]

Note 2.p.498. The some p. 54.

If the jails were farmed out, it is clear that the prisoners had everything to fear from their jailers; but this is outside our subject. The cells grouped in the vicinity of a hall of j justice are those evidently presenting most interest, and whose purpose cannot be doubteda Now there exists in the municipality of Sens a complete prison beside the hall of justice, where the accused were judged. That hall is situated in the ground story under the great hall of the synod; it is vaulted on a middle row of columns. The prison occupies about a quarter of the space, and is placed at the end of one of the two a aisles. We give the plan. (Fig. 1). The entrance of the palace of the archbishop is at A and the court at B. The sairs C lead to the great hall in the second story. By the wicket D one e enters the court room E. The wicket G gives admission to the cell H with a tunnel vault. At I is a slab pierced by a hole communicating with a privy vault, and an iron bar is fixed in the wall at a height of about 2.0 ft, intended for passing the chain that keeps the prisoner seated. A stone hood K prevents the prisoner from seeing the syy through the window L, very high above the floor, leaving him only a reflected light. But this cell presents one curious peculiarity; over the very low wicket G is a little stair that leads to a little cell placed over the office M, and which by a window is in communication with the cell H. Thus could be placed there either a guard or a person to gather the least words of the prisoner. From the place occupied by the latter, it was impossible to see the w window of the little cell because of the hood that deflects the external light.

A second wicket N. gives admission to three cells, O, P, Q. The last was quite spacious and was furnished with a privy s seat. The cell O does not seem to have been intended to confine a prisoner; it receives no light from the exterior, but its stone floor is pierced by the trap R opening into an oubliette, go in peace or paradise, as then said. At M is a privy opening directly into the court room by a door S. If we lift

the trap B and descend by means of a ladder or rope into the dungeon A, receiving air if not light by a sort of flue B. T The privy vault of the prison being at C at the level of the dungeon, the prisoner had a privy seat raised several steps at D. We also found in that "paradise" a wooden wainscot placed in the corner near.the ventilating flue to protect the prisoner from the dampness of the walls. On the fear that the unfortunate cast into this dungeon might seek to escape by p piercing the walls of the vault, the thickets that extends a along the stairs descending to the cellars of the municipility is covered outside by wide wide panels of iron placed inclined and thus holding together all the stones.

If this prison presents few traces of the sojourn of men, it is not so with the cells of the ground story, that and especially cell H are literally covered by engravings and rude sculptures dating from the 13 th, 14 th and 15 th centuries. Th There is seen a crucifixion, a tournament, inscriptions and names, incised in the plaster coating; for these divisions and internal walls are of rubble covered by a thick coat of plaster.

We have nowhere found so complete an entirety of dungeons and prisons without suffering any modification since the epoch of their establishment.

This prison was built at the same time as the official building of Sens, and consequently dates from about the middle of the 13 th century. All these vaults, including that of the 1 lower dungeon, are tunnel vaults built of rubble. Only the vault of the privy vault is composed of parallel stone arches with intervals of rubble laid on the extradoses of those arches.

The prisons of the castles are not generally grouped, but are separated from each other. Many towers of castles contain cells. but we know of none presenteng so many and so beautiful (if this term can be applied to a cell) as the castle of Pierrefonds In that residence a luxury of space extends even into those cells. Of eight towers, four possess two stories of dungeons; one lighted and ventilated, the other absolutely deprived of light. Fig. 3. gives the plan of one of those towers (that at the northeast) at the level of the upper cell situated below the ground of the court, but much above the external covered way. One descends to this cell by the screw stairs. It is circular with a diameter of 13.1 ft. Two doors close the corridor

B. It receives light and air by two slots C, and is furnished with a privy vault D. At the centre of this circular room is arranged a trap opening at the centre of the vault covering the dungeon absolutely closed, but likewise supplied with a privy. Fig. 4 gives the section of these two rooms. [1] One sees in this Fig. that the upper cell is spacious, aboundantly lighted, ventilated and perfectly sanitary. The vault is composed of 6 pointed arches and is 3.9 ft. thick, to prevent any attempt to communicate with the prisoners; the hall A was on the level of the court and was intended for habitation. This section shows the lower dungeon, whose floor is on the level of the external covered way O. One can descend into this dungeon only by the orifice pierced in the vault, which was closed by a stone plug and a locked bar. The unfortunates shut up in t that sort of stone bell did not have to fear dampness, for the walls are perfectly dry, but received neither air nor light from the exterior. The prodigious thickness of the walls and their actual construction could leave no chance to escape. One will observe that the vault of this dungeon is built of regular horizontal courses like all those of the castles and not of voussoirs. In one of these dungeons (that of the northeast tower) a crucifixion is rudely incised on the internal wall, the work of some prisoner who could only execute this work by feeling, and then two names and some formless outlines. In the dungeon of the middle tower (W), we discovered the skeleton of a woman crouching in the niche forming the privy. The construction of these lower stories is executed with as much care as that of the parts of the castle intended for habitation. The surfaces are admirably cut, and the beds have an irreproachable regularity. The southwest tower contains an oubliette at the middle of the lower dungeon. (Art. Oubliette).

Note 1.p.481. In this section we have made sections through the stairs, the passage and one of the slots, as well as through the privy and the lower vault.

We have likewise discovered low cells iy the towers of the city of Carcassonne. One of these cells belonging to the old palace of the bishop had a pillar in the middle of the chamber with fetters attached to that pier, so that the prisoner could not reach the inside surfaces of the walls. Human bones were still held by the chain. Yet we should state that many

cell interiors do not appear to have been occupied. Some present no trace of a human being, and seem as left by the hands of the mason. Let us add that in the residences of the lords of the middle ages, the name of dungeon is often given to cellars intended to receive provisions. It is unnecessary to exaggerate the use of this means of repression, and in taking i into account the customs of the time, one can even regard these prisons and dungeons as being established with regard to conditions of health, that have not always been observed during the last centuries.

PROFIL. Profile. Moulding. Outline.

Understood in architecture as the outline of a moulding. T The profile of a cornice is the section perpendicular to the face of that cornice; the profile of the base of a column is the section normal to the curve of its circumference. To cut a moulding, cornice, belt or archivolt, the profile is given to the stonecutter. One cannot give the name of profile to t the horizontal section of a pier or jamb; these are horizontal sections, plans and not profiles, for profile always denotes a vertical section or one nor mal to the curve of an arch.

Profiles are of major importance in architecture; they are expressions of the style, so to speak, and one of the most vivid expressions. The architectural styles regarded as art types have each possessed profiles, whose trace is derived from a principle essentially logical, and one can even say that only the styles of architecture that rise to the height of a superior art possess profiles. In fact, all architectural styles cannot be regarded as constituting an art. Some a are merely a structure, others being only a mass of forms without logical sense. Without going outside the limits of this work, we cannot develop all the conditions, that tend to establish this distinction between the architectural styles attaining to art, and those which are only a confused expression of that need natural to man to ornament his dwellings or his monuments. It will suffice for us to state that profiles have a definite signification only among peoples basing every expression of thought on logic. The Greeks of antiquity were the f first to give to the profiles of architecture a form derived from reasoning applied to the object. Before them, architecture

among Egyptians, for example, and properly speaking, did not possess profiles traced because of the object and the material. Among the Egyptians, profiles are very rare and are only of one hieratic form; they are based on tradition and not on reasoning. Already among the Ionians the profile is an expression. Among the Dorians it is drawn to satisfy a material necessity and with a view to produce a harmonious effect; it has its o own laws and is not the reaulh of a caprice. Thus dating from the complete development of Greek architecture, the profiles belonging to the architecture of the western peoples have their periods, that permit them to be classified in a systematic order. A profile of the brilliant Grecian epoch is recognized at first sight, without its being necessary to know to what monument it belongs. It is the same with the Roman profile of the empire, the Byzantine profile , the Romanesque profiles of the West, and the Gothic profiles. Certain profiles belonging to very different architectural styles can have , and in fact have had singular analogies; thus are established relations between the lines of Grecian profiles and those of profiles employed in the 12 th century in the West. On the contrary, architectural styles very near each other present profiles drawn on principles absolutely foreign to each other. There is no analogy between the profiles of the Romanesque schools that ended in the 12 th century and the profiles of that arising in Isle-de-France about 1160. The profile of the empire essentially differs from the Grecian moulding. The study of mouldings is therefore necessary:-- 1, to recognize the principles that have controlled the different styles of architecture; 2, to classify these styles and determine the dates of the monuments. From the moment that the monuments have been studient with some care, for example, it is easy to recognize that such a profile is only derived from such another, and t that consequently it is later than it; that a certain profiles belong to an art that rises or that tends to its decline.

In every profile are two elements, utility and the more or less true feeling of form and for the effect that form should produce. Feeling is here nothing but the means of translating a need into an art form; but this feeling is itself subject to certain laws from which one cannot wayder, and whose importance can be appreciated at once.

What characterizes the profiles of the beautiful epochs of a chitecture is the true expression of the need that they must satisfy, and let us say, a distinction on their outline, that accen s them to the eye and engraves them in the memory. This distinction is derived from a sobiety of means, from the choice in curvature anf a refined observation of the effects produced by light. There is a certain profile in the outline of which one can recognize the hand of a consummate artist, with a delicate mind, and a thoughtful and wise construction. No part of architecture is less subject to caprice or fancy than this, and one can say of the profile what is said of the style:- "that the profile is the architecture."

The Romans were little refined in the matter of art, and do not appear to have attached importance to the tracing of profiles, and if in some of their monuments of the commencement of the empire, one notes the intervention of a certain taste in these architectural details, i is necessary to thank for this the Greek artists that labored for them. It is even already shown that the profiles reproduce only the hollowed curves, copies executed with more or le s care, but which are only a sort of exaggeration adopted among Greek and Etruscan peoples, evidently types whose origin and reason of existence therefore have been lost. At the end of the empire the execution is defective, and the profiles are softened and heavy, seeming to be traced by chance or left to workmen that daily weaken the primitive types, and absolutely lacking character, they are recoknizable only by even the negligence of their drawing and execution. We do not speak of the mouldings, also rare, that one can observe in the monuments of the primitive Romanesque epoch, the last weakened reflection of the Roman decadence. It is only at about the end of the 11 th century, when architecture tends to free itself from the corrupt traditions and to seek new ways, that one can verify in the mode of tracing the mouldings certain methods borrowed from Byzantine art, t the only one to which one could then have recourse. Yet these borrowings are not made in the same manner over the area of existing France. Schools already appear, and each of them proceeds differently in the manner of interpreting the profiles of Byzantine architecture, as in the mode of interpreting the local Roman traditions. Thus for example, if the people of

Perigueux built after the end of the 10 th century their Byzantine church according to the plan and general principles, t they retained in tha edifice the profiles of the Roman decadence; the soil of Vesonne at that epoch being covered by Gallo-Roman edifices. If the architects of Berry and upper Poitou at the beginning of the 12 th century retained in the arrangement of the plans and the general ideas of their edifices the Roman traditions of the empire, their profiles are evidently borrowed from the Greco-Roman architectse of Syria. In Provence, on the banks of the Rhone, from Lyons to Arles, the profiles of the Romanesque period seem traced from those of the Byzantines. In Auvergne is established in architecture a sort of compromise between the mouldings of the Gallo-Roman monuments and those brought from the East. In Burgundy the edifices are generally built of hard stones of large dimensions, and during the 12 th century have an amplitude and power, that one does not find in Isle-de-France and Normandy, where men built them with soft materials; yet in spite of the defference between the schools, one recognizes at first sight a profile of the 12 th century among those earlier or later than that epoch. The characters belonging to the time, if possible, are still more decisive during the 13 th, 14 th and 15 th centuries, a although certain schools persist. Those facts can be explained thus:- for the profiles there is a principle that controls their form by periods independently of the schools; then there is the last feeling dependent on the school.

It is a general law that governs even at first the tracing of the profiles of the architecture of the middle ages, This law is very wise; it requires that every profile be made within the height of a course. Compelled to submit to this, the architect draws his profiles at the scale of the structure, a and not according to a conventional scale and a module. For example, it results that if two edifices are built with materials of a given dimension between beds, one having 32.8 ft in height and the other 98.4 ft., the cornice of the first will be very nearly of the same dimensions as the cornice of the second, i.e., these two cornices will be taken in one course of the same heights. In that the profiles of the architecture of the middle ages differ in principle from the profiles of ? Greek and Roman architecture. During the middle ages the pro-

profile is at the scale of the structure, like architecture itself. Because the use of the orders and of the module, the architects of Grecian and Roman antiquity must necessarily t trace their profiles according to a relation to proportions of an order, without taking into account the dimensions of the materials; thus we see that in the same country, if they can profile a cornice of a little Corinthian order in a single c course, passing to a great Corinthian order, they will profile its cornice in two or three courses. Proceeding from a different principle, the architect of the middle ages will give grandeur to a profile, not by means of the enlargement of a drawing, but the adoption of a different drawing. Thus for example, h having to place two bands on the surfaces of a great and a small edifice, he will, if the materials require it, give the same height to the two bands, but he will trace the band of t the large monument according to the profile A, and that of t the little monument according to the profile B. Profile A appears stronger, more accented and at larger scale than profile B. In the adoption of this new principle, there was ample material for the observations of the artist, the subject of a v very delicate study of effects; and if the architect of the late empire, having given the principal dimensions of an order, could no longer have to be anxious concerning the profiles of that order, it was not allowable for the architect of the middle ages to leave to the workman the care of tracing the p profiles of his monument, since it was by this trace that he could give the scale of the whole. This being so, one comprehends how architects accustomed to regard the profiles only as an elastic trace, which diminishes or increases by reason of dimensions given to the entirety, could affirm that the p profiles belonging to the western monuments of the middle ages were due to chance. But this is a language necessary to be kn known, a language that has its perfectly defined laws.

Profiles have two reasons for existing; the first responds simply to a necessity of the construction, the second is derived from pure art. It is clear that an external profile of a corniceis destined to throw the rainwater away from the surface that it covers; that a profile of a substructure is nothingbut a footing to give a bearing to the lower part of a wall or pier. But it does not suffice to fulfil these functions, it

is also necessary for the eye to find in the curve of these profiles a striking expression of their utility.

The profile of the Grecian Doric capital is admirably drawn to express support; and if the architect of the middle ages had anything to reproach it with, this is not to bear a load in proportion to its robust curve, since being corbelled on t two sides, this capital supports nothing. It is the rigorous expression of a need, to which the architects of the middle ages first applied themselves in tracing their profiles; the need of being satisfied, they sought to render the expression sensible to the least experienced eyes, and it must be recognized that they had succeeded in it much better than did the architects of antiquity, including the Greeks. An error too widely diffused is to believe that a profile is beautiful in itself, and this error seems to have been shared by the Greek architects and those of the Romans during the empire. A profile has only a relative value, and what produces a satisfactory effect here will be injurious elsewhere. For example, the architects of the 13 th and 14 th centuries never gave to the internal and external profiles of the same edifice the same curvature for the reasons:- 1, that the needs they must satisfy externally and internally differed; 2, that the effects produced by direct light cannot be the same as those produced by diffused light. A profile lighted from above downward by the sun or from beneath upward by reflection, is modified to the eyes; then art intervenes, based on refined observations.

The earliest profiles that we observe in the primitive edifices of the middle ages in France, and particularly in Isle-de-France, Valois, a part of Champagne, Burgundy, Nivernais and Auvergne, if adapted to bands, cornices, rounds and abacuses of capitals, consist in a simple plane or bevel (Fig. 2) starting from the face of the wall or resting on corbels. But one soon recognizes:- 1, that these profiles do not protect the surfaces from rainwater; 2, that they produce little effect; for if the solar ray be above the line a b, all the beveled portion c b is sunk in the shadow, if the solar ray be the l line c d, the bevel c b is in the light anf is almost confused with the fillet d c. From the beginning of the 11 th century, men sought to obtain more relief or more effect by cutting a groove o above the large bevel (Fig. 3). Thus when the solar

ray was in the prolongation of the bevel or even above it, th they obtained a luminous stribe between the fillet and this bevel; then to avoid the flow of the rainwater, a drip g was cut below the bevel. The bevel was then included between two grooves more or less deep, which accented the half light generally diffused over this inclined plane and gave relief to the profile. Then to slightly hollow the bevel in the form o of a cavetto requires but small effort, though the result obtained is relatively considerable. In fact (Fig. 4) by assuming the solar ray in the direction of the dotted lines, beneath the upper fillet is obtained a vivid shadow and then a light a; below that luminous line is a shadow b with reflections a and consequently soft; then a luminous line c slightly veiled by a half tint; then the cast shadow d. However high is the sun, the luminous line a always appears, and the great cavetto is at least modeled by a reflection, even if it does not receive light on its lower portion. However low is the sun, there is always a strip of shadow above a and a half tint at b. By this procedure with a small projection, the designer produced an effect of relief greater than in the preceding example.

These great cavettos soon appear soft, the slope is divided into several members as seen in Fig. 5, giving the profile of the abacuses of the capitals of the porch of the church of Creteil near Paris (second half of the 11 th century). By striking the moulded members in the plane of the bevel, the light produces a succession of shadows, half tints and lights, that give to such a flat profile a much greater value than it really has.

The architects of the 12 th century by their system of construction and the nature of the materials, that they use in the work, desiring to avoid great blocks, give but little projection to their external mouldings, but they seek by the section to supplement that lack of relief, and thus they obtain remarkable results. When one draws the monuments of that epoch, he cannot believe that such clear, lively and sharp effects can be obtained by the aid of profiles with such slight relief. For example, the profiles of the old tower of the cathedral of Chartres, although belonging to a colossal monument, have scarcely perceptible, though visible afar, and fulfil their object in a manner absolutely satisfactory. But the external

mouldings of that period are rarely drawn with a view to throw off rainwater; the artists who gave them the curvature appear to be especially occupied with the architectural effect, with the direction of the lights and shadows. They have only observed that on the surface, a series of shadows give it importance by compelling the eye to stop there.

The architects of the middle of the 12 th century were certainly most skilful tracers of profiles with small projections in the work. They adopted the accentuations, if one may so express it. In the words of the language, the accent falls on one syllable. If the word is composed of two syllables in French, it i on the first with some rare exceptions; if composed of three syllables, it is on the first or second; if of f four, on the last or next to the last. In the old French, that concerns the language of oc or that of oil, the accent is perfectly regular; it is the accenting that even invariably indicates the etymology. Well, in the drawing of profiles of the last Romanesque period, in the epoch when the architecture w was being made, like languages, the accentuation is always m marked. A profile thus becomes like a word; instead of being composed of syllables, it is composed of distinct members and its accentuation is regulated. But the commencement of a profile is according to its position; if the profile is a base or socle, its beginning is at the upper part that first supports; if the profile is a band or a cornice, its beginning or first member is at the lowest point, that starts from the front of a surface. Thus (Fig. 6) here at A and B are two base[1] projections, each composed of three members' the accent is on the second member, and that accent is marked by the strong shadow projected on the scotia at a. One even notes that to accent this second member more, the scotia in profile A has been fluted.

Note 1.p.490. Profile A comes from the portal of Notre Dame of Chartres, 12 th century; profile B is from the old tower of the same church.

At C and D are traced two profiles of bands and abacises;[2] the first member is at the bottom, and the accent on these two profiles, one composed of three and the other of two members, is on the first member, an accent indicated by the strong shadow projected at b. In the example of Fig. 5, the profile (we use the word) is not yet formed, and the accenting is vague. In

the formation of words, French has habitually proceeded by co contraction, always retaining the syllable on which is placed the accent. From dominus it made dom; and of vice-dominus, v vidam; of dominarum, donger, dangier and danger; of vassaletus, vaslet, varlet; of consobinus, cousin; of palus, peu, then p pieu; from the verb cogitare, cuider; from flebilis, fieble, now faible; from augurium, heur, from which is malheur; from aranae tela, arentele, an old lost word that is much better t than toile d'araignee; from soror, suer (pronounced soeur) to the subject; from sororem, seror to the rule, as infans gives ense to the subject, and infantum, enfant to the rule,[1] as abbas has given abbe in nominative; abbatem, abbe in the objective, etc. Now it is interesting to observe that in the composition of architectural profiles, the masters of the middle ages proceeded similarly by contraction and always retaining the accented member, omitting most of the others. Let us return to the examples given in Fig. 6. We see that the profiles of the base have retained the upper torus of the Roman base, that they have more strongle accented the scotia, and that they w weakened the lower torus by reducing its relief. The accentuation of the Roman profile was also most on the scotia.

Note 2.p.490. From the old tower of the cathedral of Chartres.

Note 1.p.491. Until the 13 th century the French language retains two cases; subjective and objective. (See Histoire de langue francaise by M. Littre). Of these two cases, **modern** French has retained only the objective.

If opposite the profile D we place an analogous Roman profile, a profile E of a band or impost, we see that in the Roman profile the accented member is indeed e; the master of the middle ages in the band D has suppressed the member f, has p placed the accent on the member e, but has **singularly** reduced the member g.

But during the 12 th century was produced in the art a work of transformation, is in the language. Different influences a acted; at first and in the first rank the Latin influence; t then those from the Orient, which are also themselves in great part Latin; the profiles are contracted and the accentuation assumes more importance. Soon is mixed with this work of transformation a new element, the logical element; experiments and uncertainty disappear, and the lay masters introduce an enti-

entirely new system in tracing profiles. Yet however abrupt or profound the transformation, by the aid of analysis one can always recover the elements.that served to reproduce it. Let us in fact proceed by analysis, and we shall see how from Roman profiles the masters of the 12 th century came to trace a profile, that seems no longer to retain anything of its origin.

In every work in analysis, it is necessary to know the primitive elements. The architects of the middle ages at the epoch called Romanesque could have only the elements in their hands. Those elements were the remains of Gallo-Roman edifices, and those brought from the East, mixtures of Grecian and Roman a arts. Now only speaking of profiles, those elements being for the most part no longer constituted logically, could neither give imitations or furnish logical interpretations. There remains little more in the trace of the profiles of the Greco= Roman monuments of Syria, than a delicate feeling for effects, a marked accentuation, further very superior to all that was left by the Roman decadence in Italy and on the soil of Gaul. The prominent character of the Greek profile of the best time is the alternation of plane surfaces and of moulded surfaces, it first having a considerable relative importance, whether one regards the profile of entablature as derived from a wooden or a stone structure, the appearance of a squared timber or a block of stone dominates, and the mouldings only seem to cover the joints, to be transitions between plane vertical a and horizontal surfaces. That was very logical, as we stated in the beginning of this Article; but the Romans, for whom art was scarcely expressed except by luxury, profusion and richness, must necessarily take that delicate sobriety for poverty; like all the architectural members, the entablatures were then covered by more developed mouldings, relatively to the plane surfaces, more numerous and frequently decorated by ornaments. It suffices to compare the profiles of Greek orders, Doric, Ionic and Corinthian, with those of some Roman orders from A Augustus to Trajan, to prove that the latter add moulded members, or at least give them a much greater relative importance. Gradually the plane surfaces are stifled under the increasing development of the mouldings; so much so that at the end of t the empire those plane surfaces have almost entirely disappe-

disappeared, and even the friezes are traced in curved lines. But still the Roman, who does not reason in the matter of art, retains all the members of the entablature, although that entablature has no reason for existence, for example, between t the capital of a column and the arch or vault.

When the genius of the Greeks found itself in possession of the architecture and no longer had to submit to the Roman rule, it did not reject the elements of construction adopted by their ancient masters; on the contrary, it uses them, retains t the arch and vault, but its logical spirit leads it to modify the entablature of the order in accordance with the new functions that it must satisfy. Even more, it adopts the arch on the column, entirely suppresses the entablature, and as in the Romano-Greek edifices of Syria, the Greek often rejects the placing of a platband on the column, henceforth separating those two members previously united; separating them, he made of the new entablature a contraction of the antique entablature. All know that the Greek entablature, and consequently t the Roman entablature placed on an order, consists of the architrave, formerly called the lintel, extending from one column to the next, of the frieze that gains the depth required to receive the internal ceiling, and of the projecting cornice, that shelters the whole. To this rule are few exceptions until the end of the empire, so that the entablature is a part of the order. The Romans were bad logicians in the matter of art, and placed a complete entablature to crown an edifice, e even when there was neither an order of columns or of pilasters under it. Yet if these three members were perfectly justified when necessary to span an intercolumniation, they have no reason to exist when the column is absent; then the cornice alone should suffice. The Greeks of Syria reasoned thus. At t the tops of their monuments, in which the column no longer has any function except to support arches or the lintels of galleries, the antique entablature is contracted. The frieze [1](Fig. 7) is only indicated by the great torus a, it is confused with the architrave A, and the cornice B alone remains entire. The architrave itself almost entirely loses its vertical planes. Thus the new method of profiling the entablature appears. Not being associated with the order, it tends to escape from the rules imposed by the construction of the order. In monuments

of small dimensions like tombs, the entablature abandons all traditions, and it is traced according to a new and rational method (Fig. 8). The corona is independent of the lower mouldings and is beveled; it is a shelter, the gutter of a roof, and the moulding supporting it is merely a corbelling intended to prevent the overturning of the projecting portion. These profiles, that come from the monuments of the 5 th century, drawn by count de Vogue and G. Duthoit between Antioch and A Aleppo, will furnish us with starting points for our Romanesque profiles of the 12 th century. In fact (Fig. 9), placing in parallel some of these profiles of the Romano-Greek architecture of Syria with those of France, we shall recognize perfectly that the latter are inspired by the former, but the French artists have proceeded by contraction, according to their methods. The profiles A come from bases, those at B from socles, those at D from lintels and bands belonging to the monuments of northern Syria. Now profiles A' are from bases, those at B' are from socles, and those at D' from bases belonging to the nave of the church of Vezelay, which dates from the first years of the 12 th century. The analogy between the methods of tracing these profiles is striking; but the Cluniac profiles of Vezelay are all more or less contracted, although the accenting in each one is sensible. Thus in the profiles of b bases, the accenting is invariably on the scotia a, as in profiles and socles on the first member and in bands on the first lower member e.

Note 1.p.493. From the great tomb of Kherbet Hass.

If in Romano-Greek profiles the plane surfaces have almost entirely disappeared between the moulded members, they no longer exist in the profiles of Vezelay, or are reduced to fillets of little width. In fact in a transformation preceding by contraction, for example, the surfaces g must first disappear; but also as the profile contracts,the accenting assumes more importance, and in fact the French profiles appear more accented than those from which they are derived. If one finds exceptions to this rule of accentuation, this is at the moment when Romanesque architecture tends to transform itself anew a and to give place to the style called Gothic. Then sometimes as in example C, taken from a base of the columns of the sanctuary of the church of Vezelay (end of the 12 th century), t

there is experiment and uncertainty. This transitory state only lasts an instant, for in construction of that sanctuary, except these bases that naturally must have been cut and set first, all other profiles evidence a very free art and a tracing of profiles based on new principles.

These transformations by contraction do not cease to be produced in the trace of profiles of the 12 th to the end of the 13 th centuries. Thus, to give here only a very apparent example, this (Fig. 10) is a trace of the band A very frequently employed in the edifices of the middle of the 12 th century, like the church of S. Denis, and cathedral of Noyon, the church of S. Martin of Laon, etc. The profile A is takin within t the angle a b c and consists of a wash a e, a groove f, a wide cavetto g, and a groove h. The round with its torus o is the accented member. Observing that this profile is not of a nature to throw off the water from a e, the architect of the beginning of the 12 th century, while retaining the same projection given by blocking out, traces the profile B. He sensibly increases the upper inclination, makes a square return, cuts at l a pronounced drip to reject the rainwater, and contracts the lower profile. A little later, the architect still increases the inclination and retains the drip (see trace D), and contracts more the lower moulding while leaving to it only its accentuation, the round m. About the end of the 13 th century, the designer again increases the inclination (see trace E) and retains only the drip, which is confused with the old cavetto g. Of the source in these remains only the fillet o. Thus from the Romanesque profile derived from a foreign art, the Gothic architect by a series of logical deductions has obtained a s section very different from that serving as the starting point. By gradually increasing the inclination of the upper member of this profile, terminating that slope by a corona very differently accented from the antique corona, contracting the lower moulding, even to suppress it entirely, the designer of the school of the 13 th century has made a useful member of the band with no decorative signification, a means of throwing ra- rainwater from the surfaces, without having to fear even the effect of its rebounding from a horizontal or slightly inclined surface.

Yet if it concerns the crowning of an important edifice, a

pronounced projection is required. A single course cannot suffice; the architect of the growing lay school always proceeds by contraction. From the profile of the Romano-Greek cornice became the Romanesque profile, he takes only the rudiments. In the example of Fig. 7, we have seen that the members of a antique architecture are nearly complete. The two faces b, d, although much reduced, still remain; by compensation, the upper profile c a is developed at the expense of these faces. T The frieze a b only is a round crushed between the cornice a and the architrave. The designer of the end of the 12 th century (Fig. 11),[1] suppresses the frieze, whose existence is still suspected in some monuments of Romanesque architecture; of the architrave he retains only the developed member, abandoning the others, and of the cornice he makes only a corona, as in the preceding example.

Note 1.p.497. From the north transept of the cathedral of Noyon, about 1170.

Yet the Romanesque architects during the 11 th and beginning of the 12 th centuries habitually compose cornices with a s series of corbels supporting a slab.[2] This mode is simple in construction and permits giving a very rich appearance to this architectural member at little cost. However numerous and well drawn are horizontal mouldings, they cannot produce this brilliant play of lights and shadows of the cornice with corbels. In the design of their crowning cornices, the architects of t the beginning of the 13 th century rejecting corbels, that a are unsuitable for great monuments, and recognizing the insufficient effect of mouldings, even projecting and multiplied below the corona, made of the first course a great cavetto, t that they decorated by large leaves or crockets,[1] and a corona of the second course. Until then the architects seem to h have followed their feeling in the tracing of profiles, whether the effect or task indicated to them the need; they sought by empirical means, let us say, to profit by the light to give an expression to their profiles. However numerous may be the examples of Romanesque profiles that we have been able to collect and compare, we can subject them only to certain general principles, whose value we emphasize, but which are not derived from purely geometrical procedures. It is entirely otherwise when one takes up the architecture of the lay school of

the 13 th century. Then geometry establishes itself as mistress, and the profiles thenceforth are traced according to fixed l laws derived from angles and circles.

Note 2.p.497. Art. Corniche, Figs. 1, 2.

Note 1.p.498. Art. Corniche.

It is necessary for us to furnish here a number of examples to demonstrate the universality of these geometrical methods. We must restrict ourselves and choose those most apparent.

Let us take the crowning mouldings that externally take the place of the antique cornice, and that crown all arrangements of our buildings of the commencement of the 13 th century. T Those courses, of which Fig. 11 gives some of the first types, are drawn at certain angles. If very much inclined with the angle of the wash at 60° (Fig. 12, A), this is the side of an equilateral triangle (do not forget this point). the square part of the drip a, returned at a right angle, gives an angle of 30° with the horizon, The face d of the drip being determined according to the strength of the stone and the effect one desires to obtain. These faces being wider as the corona is placed higher, one takes two thirds of that face, which being laid off on the line c d extended to b, gives the radius f d; the drip is traced thus. Erecting a vertical from the point f and tracing a horizontal from the point d, and from the point d of a line at 45° with the horizon, one obtains the point e, the centre of a circle with radius e g. Tracing a line e h at an angle of 60° from the point e, one obtains on the line d b the centre h of a circle with radius h i. Tracing a horizontal from the point h, and from the point k, the bottom edge of the profile, also tracing a line at 30° from the horizontal, one finds the point l, centre of a circle with radius l m. Thus t the profile of the crowning mouldings as drawn, inscribed within the block c o k.

If the wash be less inclined, its slope is given by a line at an angle of 45° (see trace B); the face of the drip is therefore inclined at 45°. Taking two-thirds of this face as before, and transferring this length on the prolongation of the line c d, one obtains the point f. From this point draw a line at 45° and a vertical f p; from the intersection of this vertical with the arc of a circle drip d p, by drawing a line p s at 45°, one finds the point s, the centre of the circle with

radius s t. Drawing a line at 45° downward from this point t, and from the centre s a line at 60°, one obtains a point of intersection v, centre of a circle with radius v o. Drawing a horizontal from the centre v, dropping a vertical to the line c d prolonged, one finds x. From this point x by drawing a l line at 30° to the horizon, one obtains by the intersection of this line with the horizontal a point y, centre of a circle with radius y n, and the cove z is a quadrant with centre at w.

If the wash be still less inclined, its slope is given by a line at an angle of 30° (see trace D). The face c f of the drip is consequently inclined at an angle of 60°. Drawing a horizontal from the point d, taking on the prolonged line c d one third the face of the drip, one obtains the point f. Drawing a line at 30° from this point, therefore perpendicular to the line c f, the intersection of this line with the horizontal gives the point g, centre of a circle with radius g h. Fr From the centre g dropping a line at 60°, and a vertical from the tangent point o, one finds the intersection p, centre of a circle with radius p q. Drawing a horizontal from the centre p, the centre s of the last circle is placed on it, whose diameter is more or less great, according to whether one desires a more or less pronounced extreme case. For washes of small inclination, the drip is not generally traced as an arc of a circle, because this trace (as indicated at C) would not give an angle sufficiently pronounced to ensure a quick drop of t the water.

In these three examples one will note that the most projecting profile is that of the crown moulding whose was has the greatest inclination; this is that in fact these coronas are those placed at the base of great roofs and must support a w wide gutter and sometimes even a balustrade. The pronounced i inclination of the wash thus occupies small space. In the second example the cornice is made to leave above it only a narrow passage; thus the wash of the corona occupies space and the profile is less projecting. In the third, the wash of the corona joins an upper vertical face and it approaches the horizontal to not give too long a wash. For example, so are traced the washes of the cornices of ne lower arrangement of the apse of Notre Dame of Rheims, that join the faces of the upper buttresses.

But these three mouldings surround a frieze with foliage, as around the choir of the great nave of Notre Dame of Paris. If those mouldings only form simple bands between two plane s surfaces, if they do not fulfil the function of crowning, if they do not surmount a frieze, they have less projection and are generally very inclined., varying between 50° and 70°.(See the same Fig. 12). That given at G is traced by the following method:- the centres of the circles are placed on the horizontal lines drawn from the angle a and from that at b, and obtained by lines parallel to the verticals. If the band-corona has still less projection as at H, its drip is only a semicircle with centre placed on the prolongation of the lower face of the moulding. Also sometimes, as in the example given at P, the profile of the moulding consists of a cavetto and round. Either the cavetto is tangent to the round or the centre of this cavetto is raised to a, so as to give a fillet at g that separates the round. Then as one sees at i, a part of the circle is tangent to the two curves.

The preceding examples suffice to demonstrate:-1, that the profiles of the commencement of the 13 th century are traced by means of parts of circles; 2, that the centres of the circles are given by geometrical methods principally consisting of intersections of horizontals, verticals, and lines inclined at 30°, 45° and 60°. It does not result that all the profiles of the monuments of that epoch are identical, but they always proceed with the same methods. Thus, taking the great crowning cornice of the nave of the cathedral of Amiens in the parts not rebuilt, notably on the facade (primitive portion dating from about 1225), we find this trace.(Fig. 13 at A). Here the centre of the upper circle is obtained by laying off the width a b of the face of the drip from b to c on the line a b prolonked. The point c is the centre of the arc of the drip with radius c b. Drawing from the point l a vertical and a perpendicular to the line a c,(and which perpendicular gives an angle of 45° with the horizon), the intersection of that line with arc of the drip gives the point d, the centre of the circle with radius d e. The line d f at 45° intersects the lower edge of the profile. On this line is taken the centre g of t the last circular member. The centre n of the cavetto is likewise taken on the line at 45° tangent to the upper circle; as

for the frieze with crockets and leavesthat cover that moulding, it consists of an upper fillet, a wide hollow and a lower round. The centre of this round is placed on a line at 45° starting from the lower corner m of the profile. The width of the fillet p being known, the point o is joined to the centre of the round by a line, the length o s is divided in two parts by a perpendicular k l, on which is taken the centre of the great hollow. Here the centre of this hollow is taken on the intersection of this perpendicular with the vertical face line at n. If the hollow must be le s concave, the centre is placed farther off; if more, it is placed nearer; but the point v ne never passes the face of the lower wall. This profile being given at 1/6 full size, one will note that the frieze is 2.0 ft. high, the moulding is 0.93 ft., and that the projection of the moulding is 1.03 ft. At the end of the 13 th century, s several parts of these mouldings were remade, and the profile was modified as indicated in sketch B. Our readers are sufficiently familiar now with the methods, so that it will not be necessary to explain that employed for drawing that profile. Yet one will observe that the system of contraction is always adopted, and that in this last profile the lower round member is replaced by a simple bevel.

Is there any need to emphasize the logical sense of these mouldings? Does not one see at the first glance that they are conceived as much to satisfy well marked needs in view of solidity of effect? Thus profiles are placed at great heights a and present their mouldings to the eyes of the spectator; none lose importance by the effect of perspective, and none is diminished or masked by an adjacent member. For solidity (the first result obtained consisting in promptly throwing off rainwater), the architect has at once desired to restore strength to the stone by the adoption of this circular upper member. Thus he has been able to cut a gutter in the moulding. At the inner angle of the gutter is no weakening. Then in obtaining a play of light and shadow comes the intermediate cavetto, and the smaller lower round, but which suffices to stop the entirety of the profile. Below expand these great leaves and crockets in a wide hollow, that guides the eye from the strong p projection of the moulding to the vertical face of the wall. The projection of these leaves and crockets arrests the lumi-

luminous rays under the wide and modeled shadow of the moulding.

This composition of a cornice nowise recalls the form of the Grecian or Roman antiquity, but it is beautiful, produces a grand effect, crowns the edifice admirably, and is wisely re-reasoned. What can it be reproached with? Originality?

It is to be desired that this same reproach could be addressed to our modern profiles.

About the commencement of the 14 th century, architecture tends to become lighter, the system of contraction still dominates, external cornices but rarely present two courses, the frieze disappears and is confused with the moulding. Thus in the same edifice, the north tower at Notre Dame of Amiens, t that was only completed about 1225, has a cornice of a single course.(Fig. 14, A). Sculpture has left the frieze of the 13 th century to take refuge in the hollow B of the moulding; b but since the drip of this moulding would have allowed the rainwater to run over the sculptures, the designer has added t the counter moulding a, composed of a round terminating a slope. From the primitive moulding remains the face b, which gradually lessens to entirely disappear about the end of the 14 th century; but then to better discharge the water, the round has a drip c. In example A, the lower round is reduced in thickness, and it is surmounted by a fillet to stop the sculpture clearly. We find other profiles of mouldings of the same epoch without sculpture, whose mode of drawing is simplified as for example the moulding D. Men seek rapid methods and diminish t the secondary members. Thus the great drip G, so frequently u used during the 13 th century, is replaced by the lean cavetto H, if bands are necessary, intended to shelter the walls well.

Let us leave the external profiles to occupy ourselves with the traces and transformations of the internal profiles during the 12 th and 13 th centuries. We go back and analyze the profiles of the arches of vaults at the moment when the system of construction termed Gothic was adopted about 1140 in Isle-de-France. If there be today an uncontested fact, this is that the abbey church of S. Denis opens in the time of Suger the period of transformation of Romanesque architecture into architecture really French. In the 12 th century was definitely formed the French language, abandoning the rubbish of low Latinity, to compose a language henceforth having its own gram-

the grammar and syntax. It is also in the 12 th century that more or less complete decadence of Gallo-Roman traditions in architecture give place to a new art. The transformation is sensible in the constructions due to abbot Suger at S. Denis from 1140 to 1145. The system of Romanesque vaults gives place to an entirely new principle, which has analogies neither in antiquity nor in the Italy or Germany of the middle ages. We n have emphasized the importance of this transformation in Art. construction. Henceforth Roman tunnel or cross vaults are replaced by cross vaults possessing principal, transverse, side and diagonal arches. These arches are already moulded at S. Denis, and present sections A for side arches, and B for diagonal arches.(Fig. 15). As for the transverse arches, they take the same profile as the side arches with a wide lower fillet. (The dotted line a b being the middle of the profile of those transverse arches).

These examples are furnished by the vaults of the chapels of the choir. In the north tower of this church, which dates from the same epoch, the diagonal arches already present an a angle at the intrados, as indicated by the profile C. There is no longer anything in these profiles, that recalls the mouldings sometimes decorating the transverse arches of the Romanesque period. The designer evidently desires to obtain lightness, to diminish to the eye the strength of these arches, while accenting their curvature and their spirit by a certain number of cavettos. It is in fact an arch having much more r resistance to the eyes, and appears to better fulfil its function as centering, as more numerous concentric lines accent its curvature.

About the same epoch the Cluniac school of Burgundy sought on its part to obtain the same result, but dared not free itself so completely from Romanesque traditions. In the chapter halls of Vezelay, whose construction dates back to about 1140, the transverse arches give the section E (the middle of the arch being the line c d), the diagonal arches the section F, and the side arches the section G, Fig. 15); or again the transverse arches the section H (the middle of the arch being the line g h), the diagonal arches the section I, and the side arches the section K. Tese last examples accent the reminiscences of the Romanesque profiles, these profiles are beautiful

and produce a beautiful effect, but do not have the freedom of the system already striking in the profiles of the abbey church of S. Denis. These are attempts, but not a fixed system.

At S. Denis, the architect regards the diagonal arch as a rib or round, and he traces a great round; for him the side arch is only ay engaged transverse arch, and thus he takes the section of that transverse arch. He desires to lighten the d diagonal arches and gives them small members; the transverse and side arches each have their distinct orofices.

The method does not exist, it cannot be followed according to a logical system. This is a matter of feeling and not of reasoning; the proof is that by taking ten Burgundian edifices of the same epoch, we shall find in each of them profiles of arches very skilfully traced and even very beautiful, but which open no natural path, that do not emphasize the intervention of a rigorous principle, fertile in deductions. On the contrary, the three or four profiles of the arches of the vaults of S. Denis, however simple they may be, and precisely b because they are very simple, are indeed the beginning of a system from which men will no longer depart until the 15 th century, extending it to the final consequences.

As always happens when at first is imposed a method, soon one tends to simplify the means. The architect of S. Denis, s still near Romanesque forms, gives the diagonal arch and profile different from those of the transverse and side arches; yet he adopts the round or cylindrical form in tracing both ((the profile of the transverse being the same as that of the side arch). But he soon recognizes that the arch that should appear lightest to the eye, the diagonal arch, composed of a great round is heavy, and seems to offer more resistance than the transverse arch with two rounds of less diameter, made in the two angles of the intrados. Some years later, about 1165, the architect of the cathedral of Paris frankly adopts the c consequences of the accepted method. The section of the transverse, diagonal and side arches being given, he subjects these three arches to the same system of profiles, causing their m more or less light appearance to be derived from the differences given by the sections. Thus (Fig. 16) A being the transwerse, B the diagonal and C the side arch, the mode of tracing the profiles is the same for all three. In the rectangular intrados,

he forms at each angle a round of 3.9 to 4.7 ins. diameter; d dropping from the centre a a perpendicular on the intrados, he obtains the point b, centre of the circular arc of which b c is radius = 3.2 ins. From the point d, the intersection of the line a d at 45° with the circle, he draws the line d e at 45°. He erects from the centre the perpendicular a f to avoid reductions, as he has traced the horizontal line a i from the same centre to cut the acute angle formed by the intersection of the two parts of the circle. The same trace is adopted for the three arches, as indicated by our Fig. 16. Besides the advantage of simplicity, this procedure has another merit; the members of the mouldings being the same for the three arches of a vault, give the scale, i.e., cause the different arches to appear with the ratio of strengths, that then really have with each other.

No architect, however unfamiliar with practice, is ignorant that it is easy to give an a chitectural member the appearance more or less strong by the mouldings that decorate it. The arches each having their true and necessary dimensions, adopting the same mouldinm for all, those arches present to the eyes t the appearance of their real strength; and that strength being in exact proportion to the functions of those arches, it resulted that the eye was satisfied, as far as the stability was concerned. Then the system of Gothic vaults being adopted, t the side arches did not have the span of the transverse arches, since the vaults were cross vaults, and the side arches had only half the span of the transverse arches; further the side arches were only a trace of the vault along the wall, and had no load to support; it was natural to give them only the section of half a diagonal arch.

Let us see how at the same time the architects proceeded t in the province, in which the system of construction called G Gothic arrived en the state of an importation. The choir of the abbey church of Vezelay was built a little after that of Notre Dame, i.e., about 1190; there in the drawing of arches of vaults, experiments are still apparent; the methods are not frank and certain as at Paris. It suffices for convincing one's self of this to glance at Fig. 17, which gives at A two transverse arches of the chapels of the choir, and at B a diagonal arch of the same chapels. [1]

Note 1.p.508. All these profiles are drawn at 1\10 full size.

These sketches indicate a refined feeling for effect (the three arches produce much); but method is absent. The two di diagonal arches from the high vaults of the choir (for as in many great vaults of the end of the 12 th century, the diagonal and transverse arches give the same section), sketched at D, indicate a more complete study of the architecture in Isle-de-France, and nearly reproduce the profiles of the vaults of Notre Dame of Paris. But these vaults in fact were erected s some years after those of the chapels, and the experiments h have nearly disappeared. There is manifested in the last profiles a tendency that belongs to the Burgundian Gothic school; this is the predominance of the curves over the straight lines in the trace of the mouldings. The nature of the materials em-employed was indeed for something in that predominance of the curves, but also the taste of this school for breadth of forms. While the Romanesque architects of Isel-de-France, Berry, Poitou, Saintonge and Provence cut fine profiles detailed to excess, those of Burgundy already traced profiles of an extraordinary breadth and boldness of curvature. In adopting the system of Gothic construction, the architects of the Burgundian school retained that native quality. We shall soon have occasion to admit this.

We cannot too frequently repeat, that one can no longer study French architecture by taking a single province, that one cannon study the language, unless one takes account of the d different forms of the language, that have become dialects of our days, but which actually in the 12 th century were dialects having grammars syntaxes and varied turns. No part of architecture is better adapted to show those differences of schools than the profiles, which are the most approved expression of the genius belonging to each of those schools, so that in certain monuments built in a province by a foreign architect, while adopting the methods of building and of general arrangement accepted in the locality, they clearly manifest the origin of the artist by the profiles, that are really the ordinary language of the architect. One can make the contrary observation. For example, there are Gothic monuments built in Auvergne (a province in Gothic architecture could only be in a state of importation), whose profiles are those of Auvergne\.

the desired to speak the language that he did not understand. There are other edifices like the hall of the synod of Sens, built in a province subject to Champagne influence, where the general arrangement of the system of lonestruction is local, and where the profiles mostly belong to Isle-de-France. Like the choir of church S. Nazaire of Carcassonne, where the plan, ideas, forms of piers and external appearance, are all southern, and where the profiles indicate the presence of an artist of the royal domain. This artist has expressed the ideas adopted in the locality by means of his own language. This part of our national architecture therefore merits our attention and delicate study, for it gives the means, not only of fixing positive dates, but also of indicating schools. This study s should be made in each province, for certain profiles seen a adopted in 1299 at Paris, will again appear in Poitou only in 1230, with some modifications made by provincial genius. We c could cite monuments in Champagne from 1250, that in Isle-de-France would be placed at the beginning of the 14 th century, by the aid of the profiles and by eyes little trained. Thus one should study the profiles in the only truly original edifices due to the artists of the first order, and no longer take into account certain oddities or exceptions, no more than to have perfect knowledge of a dialect, of manuscripts badly copied or of rude works. Every epoch and even our own, has p produced barbarous works, not by them is an art to be judged, nor to be studied, for a stronger reason. This study made with the eyes of a critic demonstrates to us again that in this art, so long and unjustly disdained, there exist laws as well established as in the arts of Grecian and Roman architecture; b that those laws rest on principles no les imperious: for if it were otherwise, how explain certain similarities or diversities and never departing from the dominant principle?

Let us now see some profiles of the arches and vaults around the choir of the cathedral of Amiens, that date from about 1 1240. (Fig. 13). A is the profile of the transverse arches, B that of the diagonal arches, at 1/10 full size. Dating from that epoch, the methods employed for tracing the profiles are more and more subject to geometrical laws and to regular dimensions. Thus in the profile A of the transverse arches, the lower round has a diameter of 3.4 ins. Through the centre of

this round, drawing a line a b at 45°, the intersection of this line with the vertical c b gives a b the edge of the upper cavetto. The lower round is engaged for 1/12 its diameter in the line e f. The line g h at 45/ is tangent to the lower round and also tangent to the upper round l, whose diameter is 3.54 ins. This round is likewise tangent to the vertical c b prolonged. The radius of the upper cavetto equal the radius of the round l, its centre being at i. The centre m of the l lower cavetto is placed at the intersection of the line e f with a vertical tangent to the upper round, and the radius of this cavetto is 2.6 ins. The band b c is 6.35 ins. the fillet o joins the great round by means of two reverse curves with centres at r. One conceives that these methods of drawing facilitate laying out. The vertical c o has 12.7 ins. This base being taken and the line og drawn at 45°, all the members of the profile are thus inscribed within a very simple outline. As for the profile B of the diagonal arch, its width is 12.7 ins. The face s t is 10.6 ins and the line t v is drawn at 45°. The diameter of the lower round of this profile is 5.8 ins. From the point x, drawing a line x y at 60°, one obtains the point v, the edge of the upper cavetto. The upper round has a diameter of 2.6 ins. It is easy to recognize that these lines are drawn with a view of giving to the profiles the light appearance suitable for the arches of vaults, leaving to the stone the greatest possible strength. The bottom edge on the axis below the great rounds clearly indicates the curvature, which could not be a cylinder, for the architects from the beginning of the 13 th century, as we have seen in the p preceding examples, felt the necessity when they terminated t the arch by a round, to arrest the light (diffused in the interior) on this round by a projecting rib, at first composed of two straight lines, then soon with two curves with a flat fillet. In fact, when one observes the effects of light on curved cylinders without ribs, there is a passage of half tints, of lights and shadows forming a very elongated spiral, destroying the cylindrical form and leaving undecided surfaces; so that the secondary mouldings with their cavettos assume m more importance to the eye than the principal member. It was necessary to rib this to give it all its value and make it a appear resistant and projecting, and at the same time light.

Thus they could henceforth renounce profiles of arches with lateral rounds and a wide flat filled between them, like those given in Fig. 16, which had the inconvenience of leaving even at the middle of the profile a member apparently weak, because it remained in the half tint and did not catch the light strongly. It was then a profound study of effects, that thus led gradually to modify the important profiles of the arches of vaults, and no a fashion or a capricious desire of change.

However, the architects of Isle-de-France seem to have disliked to adopt the projecting ribs under the principal rounds of the arches of vaults, until about the middle of the 13 th century. They attempted to give these arches an appearance of firmness by other means.

The parts of the abbey church of S. Denis, which date from about 1240, furnish us with an example of those attempts (Fig. 19). At A is drawn the profile of the archivolts of the side aisles; at B is that of the transverse arches, and at C and D are those of the diagonal arches. The profiles of the archivolts at A, half of which we have given here, because of their depth still partake of preceding drawings with rounds at the angles and an intermediate flat. At a we indicate a variant, i.e., the cavetto with centre at c with a straight part, and the cavetto centre at b. The profile of the transverse arch B presents a very labored drawing; the line a b is inclined at 60°. Thus as our Fig. shows, on this line are placed the centres c of the upper round and e of the intermediate cavetto e. From the centr c having been drawn a line at 45°, on this l line are placed the centres of the lower round g of the astragals h and i. Further, the round g is tangent to the inclined line a b at 60°. Now this great round is 4.9 ins. diameter and the round C is 3.9 ins.

Drawing has become more methodical than in the preceding e example, and the designer has given the lower round firmness by flanking it by two astragals, that strongly outline it by means of the black lines k. The centre of the upper cavetto is at l, i.e., at the intersection of the vertical o l with the horizontal drawn from the centre c. For the profiles of t the diagonal arches C and D, the system of drawing is no less geometrical. Here the line a b inclined at 60° gives hel centre b of the lower round, whose diameter is equal to that of

the transverse arches. From this centre b the line b e is tangent to the upper round and receives the centre of the astragal f and that g of the cavetto. Although the members may be of different diameters in the two examples C and D, one sees that the mode of drawing is the same. On the details E and F of the principal rounds we have given two of the methods employed at that epoch to rib these cylinders. In example E the sketch gives the sharp edge obtained by means of tangents at 30° (that edge being sometimes cleared for more distinctness, by means of a concave line with centre at n on a perpendicular drawn from the line at 30°).[1] In example F the centres of the arcs i, k, are taken on the angles of an equilateral triangle with side of twice the radius of the round.

Note 1.p.517.For example, for the lower rounds of the transverse arches of the S. Chapelle of Paris.

According to whether one desires to obtain a wider or narrower fillet, the section o is taken higher or lower on the c circular arcs. Experiments here produce formulas. Henceforth angles at 30°, 60° and 45° will serve us for drawing these profiles, employing the simplest methods. The Burgundian architects, that as we have stated, are such good designers of profiles, will demonstrate to us how the method can be joined to the freedom of the artist, and will become for him, if he knows how to use it, not a restraint, but on the contrary,a means of avoiding loss of time and endless experiments. We come to the moment when the art of architecture, henceforth freed from Romanesque traditions and left to lay hands, is no longer compelled to copy more or less fortunately consecrated forms, b but is based on reasoning, seeks and finds methods, that are not a restraint for the artist of genius, but prevent the ordinary artist from going astray.

The profiles, like the system of construction, of proportion and of ornamentation, proceed in a logical course favoring pr progress, and the search for the better. In fact, the architectural styles worthy to be regarded as arts, among the Egyptians,and Greeks, as with us in the middle ages, have proceeded in the same fashion; seeking by sentiment or by instinct, if you will, forms that appear most appropriate for the needs; by a series of experiences coming to give those forms a certain fixedness, then gradually establishing methods and finally for-

formulas, principles founded on true feeling and on experience. Then the architect, taking his pencil, compasses and triangles, no longer works in uncertainty in seeking the forms that his fancy will suggest to him; he starts from an established system and proceeds systematically.

We know all that can be said against the adoption of formulas; but we must state that no architecture worthy of the name has not inevitably ended in a formulary. More than any other people, the Greeks had methods leading to formulas, and if some one doubts this, we request him to consult the very remarkable works of M. Aures on that subject.[1] But the architectural formulary of the Greeks is only based on a harmonic system of proportions, developed under the influence of the delicate feeling of that people. This formulary commenced by a simple empirical method established by experience, is not a logical deduction from reasoning, but is a canon, the beautiful in figures; thus it could maintain itself no longer than is maintained the law established under the power of a sentiment; this formulary is overturned by each generation of artists. It is not the same in France under the empire of the lay schools; the method from the first is based less on sentiment of form than on reasoning; being logical in its course, it o only leads to a formula on the eve of the day, when the art is definitely lost. For from the moment that the method becomes a formula, all deduction becomes impossible; therefore in an art whose element was incessant progress, the formula was death.

Note 1.p.514. Theorie du module, by M. Aures, chief engineer of bridges and roads. -- Etudes des dimensions de la colonne de Trajans, by the same, etc.

The examples of profiles already presented to our readers indicate a tendency, at first vague, then more emphasized, to toward a geometrical methodfor tracing the different members composing it.

Feeling, but a reasoned feeling, evidently caused the invention of the profiles given in Figs. 15, 16 and 17. It was necessary to lighten to the eye the arches supporting the high vaults, yet leaving them the greatest possible strength. In the two Figs. 16 and 17, it is evident that those rounds, placed like so many ribs between cavettos, or placed in the salient angles, tend to leave to the stone all resistance, while

making it appear lighter like a bundle of astragals. Reasoning then intervened for much in drawing these profiles. Besides, it is no less evident that the architect has subjected his r reasoning to a certain feeling for form, ratios between solids and voids, and effects; but the geometrical method for drawing those profiles is still uncertain. In the example (Fig. 18) t that general method is already developed. One sees that in t this Fig. the trace A places the line at 45°, and the trace B has the line at 60° as limits of the resisting portion of the stone, the rounds being no more than an additional strength, at the same time as an apparent lightening.

In Fig. 19 the geometrical method of drawing is completed and perfected; the lines at 45° and 60° without exception receive all the centres of the rounds, and the principle of resistance of the transverse arch like that of the diagonal arches is the same as that adopted in the example (Fig. 18). The hollows are perhaps too pronounced not to alter the strength of the stone in the example (Fig. 18), but in Fig. 19 are replaced by the astragals, that while producing a very vivid effect to the eye, leave to the stone all its vigor.

Let us now see how about 1230, the Burgundian architects p proceeded in drawing the profiles of arches fulfilling the same purpose as the preceding; how the difference in quality of the material employed, the feeling peculiar to that province, caused to be interpreted the methods already adopted in Isle-de-France. Here (Fig. 20) at A is a transverse arch; at B is an archivolt; at C a transverse arch of the great vault; at D, D' are diagonal arches, and at E a side arch of the church of Semur-en-Auxois. 1

Note 1.p.515. These profiles, like the preceding, are drawn at 1\10 full size.

For the transverse arch A, the line a b is at 45°, the line c d is at 30°. All the centres are placed on those lines. The base line e f of the profile having been divided in 5 parts, one of those parts gives the diameter of the lower cavetto and of the lower round a. Here the curves are broad, the hollows are pronounced, and the materials very resistant (stone from Pouillenay), lending itself to this deep and strong cutting. In the archivolt B, the centres of the cavettos and rounds are placed on the lines at 60°. In the transverse arch C and the

diagonal arches D, D', the centres are placed on lines at 45°. In the side arch E, on a line at 60°. The breadth of those profiles contrasts with the delicacy of choiceness of those adopted in the church of S. Denis, although the church of Semur-en-Auxois may be of small dimensions relative to that of the abbey of the royal domain. The method of drawing is yet uncertain in details, and proceeds much from feeling, although in general principles it conforms to that established in Isle-de-France; but in the architecture of Burgundy, although it concerns the const uction, the composition of the masses, the profiles or the ornamentation, one always notes a certain freedom, boldness, and a considerable part left to sentiment, which g gave that school a particular character.

Burgundian architects recognize the rules and methods of the lay school of Isle-de-France, but subject them to their local character. They adopt the grammar and syntax, but the retain the turns and utterance peculiar to them.

The great Cluniac school and the nature of the limestone m materials of the country leave an ineffaceable trace of their influence on the forms of Burgundian architecture of the 13 th century. It is entirely otherwise in Champagne; in that p province the materials have small resistance, are scarce on a great part of the territory, and do not permit boldness in drawings. Thus the profiles of the architecture of Champagne, from the Romanesque epoch and from the beginning of the 13 th century, are low, small and sadly timid, if one can so speak, are encumbered by secondary members, and fear hollows. It is interesting to observe, now in a part of that province located on the frontier of Burgundy and Champagne at Sens, the architect of the hall of the synod has sought to harmonize the designs of Isel-de-France with those of Champagne. The hall of the synod was built about 1245 by an architect of the royal domain, borrowed from Champagne certain arrangements in construction suited to that province, from Burgundy certain parts of the ornamentation, from Isle-de-France the profiles, but s still modifying them somewhat according to the principles of Champagne. This tendency towards a fusion makes him hesitate; he pretends to continue the French profiles by giving them m more fullness, according to the method of Champagne. Thus (Fig. 21) he traces the transverse and diagonal arches of the vaults

of t e great hall of the first story A, reinforcing the lower round.[1] This lower round is drawn as shown by our Fig. by means of two centres a, a′. To conceal the obtuse junction of the two circles, he caused the fillet n to project. From the point a′ drawing a line a′c at 45°, he takes on that line the centre c of the second round. Drawing a line c d at 30° from the centre c, and from the fixed point e drawing the line e d at 60°, he obtains the point d, the centre of the upper round. Drawing f from the same centre c a line c f at 60°, he obtains the fillet g, and on that line the centre f of the lower cavetto, wh whose curve intersects that of the great round. He compensates for the angle h by a circular arc, whose centre is placed at i. This moulding take a depressed curvature that does not belong to the architecture of Isle-de-France, but it is elsewhere s studied with care, and assures in execution a resistant and f firm appearance. Due to the fillet b, that prevents the junction of the two circles a, a′, these two curves do not appear to be a portion of a circle; but not to develop too much in t the eye this important member, the lower cavetto encroaches on it and takes away its heaviness. The designer has thus obtained more strength without giving to his profile a less light appearance.

Note 1.p.517. This drawing is at 1\5 full size.

But all designers do not proceed with that ingenuity. In n Normandy and Maine, the profiles, while being traced according to the methods that we have just indicated, emphasize a tendency toward exaggeration of effects and a defect in the ratios of proportion. An artist from Maine would trace this profile as it is indicated at B. He would accent the intersection k; he would also give a curve to the fillet l; he would exaggerate the projection of the lower fillet m, or indeed as the profile C indicates, he would flank the great lower round by an astragal n, or even by a lateral fillet o, and he would recover the stops, fillets anf angles at p c by diminishing the radius of the second round. This tendency to the exaggeration of the cavettos, to the multiplicity of the angular especially develops in England from the middle of the 13 th century. The profiles of that country and that epoch are charged with a number of rounds, fillets and deep hollows; but the m method of drawing scarcely varies; this proves that a system

in architecture is a means of permitting everyone also to follow his own taste and feelings. Suppress method in drawing the profiles of the architecture called Gothic, and one falls into a chaos of uncertainties and experiments. Caprice is mistress, and caprice in an art which should borrow so much from geometry can only produce nameless forms. Is not this the method that gives to architectural profiles after the 12 th century in France an appearance so striking, such a particular style, that one cannot take a drawing of 1200 for one of 1220, that one cannot confuse a Burgundian moulding with a moulding of Champagne? Assume that a geometrical method does not exist, how is to be traced one of these profiles, at what poin to c commence or end? How give to all these members a proportion and harmony? How combine them together? And how much time is lost in trying for the best in an uncertainty! We have frequently seen our colleagues seek designs of profiles by the h help of feeling alone, without beforehand seeking a method; if careful, how many times would they not go over a drawing without ever being certain of having found the best?

Let us now see how in Champagne, the architects, always following the system of angles at 45°, 60° or 30°, for drawing the profiles of arches, came to give these profiles a character that belongs to their genius and accords with the nature of the materials employed.

The stone set in the work in the church S. Urbain of Troyes, which dates from the end of the 13 th century, is limestone from Tonnerre, fine and compact, resistant but brittle, as the stonecutters say, i.e., it breaks easily, either in working or when set, with deep hollows. The skilful architect of church S. Urbain, so frequently mentioned in the Dictionary, knows well the nature of the material that he employs. He knows that it is necessary not to hollow it too much, if it has to carry a load; for example, for the rounds of arches, that they should not be separated by too deep hollows; still he claims to erect an edifice of a light appearance, remarkable for the delicacy of its members. Here is how he will trace at A (Fig. 22) the archivolts of the nave.[1] As in the preceding example, he will give to the lower round two centres a, a′, a rib b with recurved lines with their centres placed on the lines a c, a′c′, drawn at 60°; the radius c b being equal to the radius a b.

From one of the centres a he draws a line a d at 45°. On that line he places the centre of the second round. But note that the architect must turn these archivolts with two rows of voussoirs, and with a side arch for the vault of the side aisle. The second round of 4.0 ins. diameter is tangent to the stepped lines of the second voussoir; its position is then fixed. Drawing from the centr e two lines at 30° and 60°, the intersection of these two lines with the stipped lines gives him t the centres of the recurves of the fillet f. The horizontal drawn from this centre and meeting the vertical stepped line gives him at g the centre of the cavetto h. The vertical f-g prolonged gives him the fillet surmounting this cavetto. He then traces the upper cavetto i, whose centre is on the vertical d j. This centre is on the level of that of the astragal k. On the lower voussoir 12.2 ins. wide, to make the fillet l sufficiently strong to resist the pressure, he draws from the centre a' a line at 45°. From the point of intersection of t this line with the circle of the round, drawing a horizontal, he places the centre of the astragal on this horizontal, taking a line at 45° as tangent. This astragal fills the space that would be too pronounced at g, and even in fear that the hollow s remaining might not be sufficiently sharp, he traces the second astragal s, whose centre is placed on the line at 45°. The same fear of hollows causes him to trace the astragal t on the second voussoir. The astragals k, t and o, have 1.6 ins diameter, s is 1.0 in. The trace of the side arch explains itself. By the aid of these astragals the designer has suppressed dangerous hollows, and still has obtained a desirable effect, in that the principal members, the rounds, further ribbed by their projecting fillets, assume their projection and importance by the proximity of the slender members and the b black lines that outline them. To place a very fine moulding, an astragal of small diameter, beside a round is to give to that a value that it would not have if isolated. The Greeks in tracing their profiles well understood that rule and applied it. By contrasts they gave value to mouldings, far more t than by actual dimensions.

Note 1.p.319. At 1\10 full size.

The drawing of the diagonal arches of the church S. Urbain given at B and C is no less remarkable. That at B must be res-

resistant, and the hollows are replaced by astragals; the one at C having no load can be more hollowed. One sees now the m method of drawing the two profiles is simple, entirely obtained by the intersection of lines at 30°, 45° and 60°. In example C the two lines at 60° give exactly the resistance lines of the stone, the members all being left outside. In the same c church and in the other edifices of the same epoch in Champagne, one sees the trace D for the lower rounds of the arches. The triangle a b c being equilateral, and consequently the l lines b a, c a are at 60°.

In the profile of the archivolt A, not only the lower round is ribbed, but the lateral rounds are also. By multiplying the members, by replacing hollows by astragals, one feels the necessity for giving more energy to the principal members of t the fillets forming ribs, by strongly arresting the light, allowing this result to be obtained.

The architects of Isle-de-France did not voluntarily decide to resort to these projecting ribs; if they employed theese for the lower rounds from the end of the 13 th century, at f first angular and then with recurves and later fillets, they adopted them for lateral rounds of the arches but rarely before the middle of the 14 th century. These architects seem to have taken up the task of simplifying the general methods, that they had first applied. The church S. Nazaire of Carcassonne furnishes us with a very striking example of this fact. This church, whose structure was built between the years 1320 and 1325, gives sections of transverse and diagonal arches, always proceeding on the system developed above, but with notable simplifications.

In the profile A of the transverse arch (Fig. 23), the lower round (5.7 ins. diameter) being traced, from its centre a is drawn the line a b at 45° to its intersection with the vertical c b, the limit of the profile. The angle c b a is divided into two parts by the line b e. Taking into account the projection the projection of the rib, on that line is placed the c centre f of the round (4.2 ins. diameter); the radius of the cavetto equals that of the round and is placed at g. The centre h of the great cavetto is placed on the line at 45°. To t trace the ribs with recurves, there are traced the equilateral triangles a i j, f l m. The same method with sensible differ-

differences sufficiently explained by the Fig. was employed for the profiles of the diagonal and transverse arches B, C, E, F. Do not forget that this church was built after the city of Caracssonne was comprised in the royal domain, and very certainly by an architect of that province of Isle-da-France, since all details of the architecture prove it. Here the projecting ribs appear on the lateral rounds, but only in the t two examples a and F.

All architecture established on logical principles and on methods dereved from those principles cannot stop in the path; it must proceed by a series of deductions. This phenomenon is observed among the Greeks, as among us during the middle ages.

Every discovery proceeding from the systematic application of a principle is the starting point of new forms.

It appears that the art of architecture, which is the creation of the second arder, proceeds like nature itself, which without ever departing from the primitive principle, develops the consequences while always retaining a trace of its starting point. If we have been seized by a profound feeling of curiosity and of philosoptic interest in gradually studying the architecture of the middle ages in France, it is because we have recognized in the developments of that art a creative s system, that carries us back to those logical experiments, na natural in the labor of its works. This art so strongly disdained, whose first fault is to have been developed among us, the second being to require for understanding, the mental stress, does not proceed as in our days by a succession of fashions, but by an unbroken connection in the application of accepted principles. So that in decomposing an edifice of the 15 th century, one can find therein the development of what those of the 12 th century give in germ, and that in presenting a series of examples selected between these two extensive epochs, one cannot mark an interruption at any point. Likewise in the order of creation, comparative anatomy presents in a series of organized beings a ladder with sensible steps and which leads us without abrupt changes from reptile to man. F For this we give really to this architecture, as to that of Greece, the name of art, i.e., wi regard it as an actual creation, not as an accident.

Do not lose sight of the preceding examples. In those exam-

examplesthe same method of drawing is adopted; experience, the need to be satisfied, the feeling of something better, of absolute perfection, evidently guide the artist. It concerns t the subjection of the material to a form appropriate to the o object, removing from it everything superfluous, in giving it the appearance that best indicates its function. Architects are not yet satisfied with the results obtained, for hieratism is the opposite of this art, always in quest of new applications, always seeking but without abandoning the creative principle. In these last examples, the material has already been reduced to its minimum strength; to lessen still the strength would be to suffer the most disastrous contingencies. But the minimum of strength obtained, it is necessary to give to these members a lighter appearance without troubling the eye. The architects have observed that the projecting ribs added to t the rounds give them an appearance of strength, of resistance, that far from destroying the effect of lightness, even augments it. They observe that bodies subject to pressure, like stone arches, resist in accordince not to their actual section, but according to the form given to that section. The principle of our modern engineers, applied with exact knowledge of the laws of resistance of bodies, for example of cast iron, the architects of the middle ages sought to apply to stone, but taking into account the properties peculiar to that material, which is far from having the cohesion of metal. In fact if a column of cast iron whose horizontal section A (Fig. 24) resists a much greater pressure than one with section B (those two sections having equal areas), it is evident that one could not give a s stone column the section A, because it would rupture at a under the load. But if a stone pier, instead of being cut according to the horizontal section C, is cut in the form D (otherwise with equal areas), the pier D must resist a much greater pressure than C, the hollows not being sufficiently pronounced for one to fear ruptures at o. To the eye the pier D will seem both lighter and more resistant than C. Let us add also, that building stone being quarried in prisms with equal areas of beds, the piece D when cut is nearer a square form than the piece C. The piece D profits better by the natural form of t the stone than that at C. But why will the pier D better resist a load or pressure than the pier C, since after all the

extension of the external surface does not give for stone, as for metal, an external surface the more resistant as it is m more extended, the sectional areas being equal? It is because the section D, presenting more bearing, is less subject to suffer deviation, and consequently has a surplus of load on a p point. Likewise in drawing arches, the resistance to pressure being exactly resolved by the section d e f (see at E), we not only increase the resistance by the additions g, h, i, but prevent deviation of the arch, that by transferring an excess of pressure to a point can cause rupture.

We have sufficiently emphasized elsewhere,[1] how the architects of the lay school had adopted a structural principle based on equilibrium, and consequently how they had adopted the elasticity of structures as a means of stability. Admitting elasticity in the construction, it was nece sary to admit its consequences in the details, i.e., in drawing the arches, a system of shores, of lateral abutments. The rounds of the arches have no other function. We have seen (Fig. 19) how when these architects mistrusted the quality of stone, when they found it brittle, the hollows were made more shallow, and were even replaced by astragals, forming a contrast to the rounds by the many black lines and slinder members, so as to leave all their real value to these. But those rounds were often a almost detached as in the examples (Figs. 20, 23), and if the material did not have a considerable force of cohesion and resistance,[1] they split at the hollow by the effect of unequal pressures. The architects about the end of the 14 th century having had occasion to note these ruptures, pretended to remedy them, yet without diminishing the light appearance of the profiles of the arches and even accenting that appearance of lightness. Thus we see them (Fig. 25) adopt profiles of arches in which the members are less detached from the mass, yet acquire an appearance of extreme delicacy. The method for tracing these arches is the same as that adopted in the last examples. the surface a, a′, b c (see the profile of the transverse arch A) is the minimum area of resistance, the two lires a c, a′b being at 60°. No hollow comes to weaken this surface, but the supplementary members, the rounds with ribs give stiffness to the voussoir and oppose its deviation. Although wide, the cavettos leave strong attachments to the rounds, and these assume

an appearance both lighter and firmer by the addition of very pronounced projecting ribs. The sketch A does not need description after all our preceding definitions.

Note 1. p.524. See Art. Construction.

Note 1.p.525. Observe that the arches traced in Fig. 23 are cut in a very compact sandstone, just as those in Fig. 20 are in stone from Pouillenay, which is almost as resistant as granite.

Always by sections with lines at 60°, 45° and 30° are the centres obtained. One would prefer to glance at the sketch B of a lower round and the mode of finding the centres of the recurves of the rib, the lines e f being at 60°. But the lower r rounds , with a diameter larger than the others, present at the sides soft surfaces with regard to the other ribbed rounds of less diameter. Then one also pretends to rib laterally these great lower rounds (see at C); thus they are given greater resistance, and they are made to appear more detached and lighter; Yet the original curve is seen again in i j, as if to not lose the principle of drawing. These lateral ribs give a too prismatic appearance to these lower rounds; they were promptly r renounced, and the lateral rib is raised to an axis at 30°. (See the example D at k). Then the generating form of the lower round appears less changed, and at this system the architects stopped at the beginning of the 15 th century.

Constructors had also recognized that the force of resistance of voussoirs is below the extrados, i.e., at m (see profile D)- On the other hand if we inquire for the means of constructing the triangular filling components of Gothic vaults, we see that these triangles are not constructed by the aid of ce centres and forms, but by means of movable wooden curves (Art. Construction, Figs. 57, 58, 59, 60); that these wooden curves are supported on the extrados of the transverse, diagonal and side arches, and that it was therefore necessary, either to m make skew gains on the angle of the extrados of these arches, or to leave a little space between this extrados and the fil-,ing. The architects of the 15 th century took this necessity of construction as a pretext for modifying the profiles of the arches at their point of contact with the fillings of vaults ; they practised making the bevel indicated at o (see profile D) to receive the end of the wooden curve, and tha contributes also to give an appearance of extreme lightness to their arches

by detaching them from the fillings, and giving more importance to to the lateral ribs.

Note 1.p.528. From the choir of the church ot Eu.

We come to the last expressions of the method adopted for drawing the profiles of arches during the first half of the 15 th century. Let at A (Fig. 26) [1] be a transverse arch composed of two superposed voussoirs. The lower round a is first traced by means of two circles; a b c being an equilateral t triangle, i.e., the lines a b, b c, being at 60°; the radius of the recurve of the fillet c b being equal to the diameter a e. At f is placed the centre of the curve of the side rib, more or less distant as one desires to have this rib more or less accented. From the centre g is drawn the line g h at 30°; from the same centre g the line g i at 60°. On this line g h is placed the centre h of the great cavetto, so that its arc may be tangent to the line g i, and not cut into the triangle of resistance. From the point h is drawn the vertical line h k. Half the width of the voussoir l m k being fixed, the second round will have as diameter the interval between the two verticals k n, l n.

Note 1.p.528. From the church ot Eu.

The rib of this round will be on the axis o p at 60°; so t that the projection of the rib does not exceed the form given by the line l n prolonged. From the centre p is drawn the line p q at 60°. On this line is placed the centre r of the little cavetto with radius equal to that of the round p. The vertical l n gives the upper fillet. The centre of the round of the s second voussoir is placed on the line p q at 60°; the rib of this round is on an axis at 60° drawn from this centre; the centre of the lower cavetto is on a line at 30°, and the centre of the upper cove is on the line p q, the chamfer s remaining for setting the wooden curves. The method of drawing is simplified; one decidedly renounces allowing to be seen the original curve of the great lower round (see sketch B); one no longer permits to be seen of the original curve of the secondary rounds more than that external one. The ribs of these rounds are placed on the vertical axes, and they are traced as indicated by the detail C, by employing for placing the centres only lines at 30° and 60°. Our Fig. further explains itself. It is necessary to remark, that if in this last example

the triangle of resistance has been weakened at t by the curve of the great cavetto with centre at v, the resistance of the lower round has been increased by becoming a concave prism. Thus area has been given to the resistance. The effect of lightness and firmness at the same time is emphasized by the rounds with vertical ribs by the cavettos that suppress the inner portion of the curve of the rounds. The cutting is less complex and the form is more easily understood.

Thus we come by a series of almost insensible transitions, all derived from a uniform method, from examples given in Figs. 18 and 19 to this; and yet if no account were taken of the i intermediates, it would be difficult to admit that the last of these profiles is only a deduction from the first.

Perhaps we may be thought to have enlarged too much on these details of the architecture of the middle ages; but we find there an occasion of emphasizing the spirit of method, the logical sense that guides the architects of the beginning of the lay school in the 12 th century.

The work of analysis to which we have devoted ourselves concerning the profiles of arches could be done for all parts o constituting the architecture of that time; thus one would follow step by step by provinces the experiments, the establishments of methods and the incessant improvements of this French architecture, that it is not permitted to admire(this is a matter of taste), but to which cannot be refused unity, science, logical depth, fixed and well defined principles, flexibility and the elements of perfectibility.

In the matter of architecture, the capricious men of our time have not always been happy in their attempts, and our recent monuments betray their efforts; which tend to prove that the art of architecture cannot do without a system added to the qualities, that we have just enumerated; and that instead of rejecting the study of the art of the middle ages, t there would be strong reasons for cultivating it, were this only to know by what means the masters of those times came to produce such grand effects, and also to not remain below their works. We admit that this will require labor, much labor; and it is easy to deny the utility of anything, which we do not wish to take the trouble to learn!

Certain persons not being able to form an equation, indeed

pretend that algebra is only a conjuring book! Why should we be surprised to hear men deny the logical sense, the cohesion and practical utility of this art, that we have allowed to be lost, and that we neither understand nor utilize its resources?

The methods followed for tracing profiles of arches are invariable, because an arch is always seen at all angles possible. Whatever the height at which it is placed, its curvatures presents to the eye its sides and its intrados under all aspects; but it is so with a band, base, abacus, and a horizontal profile in brief, whose position by the effect of perspective can mask or at least diminish a part of the members. The Greeks evidently took into account the place andthe tracing of profiles; but their edifices being relatively of small dimensions, the perspective deformations could have no great importance. The Romans do not appear to have been interested in t the influence of perspective on profiles. These are traced in an absolute manner according to an accepted method, without taking account of the position occupied above the eye. It does not appear that during the Romanesque period men modified the tracing of profiles according to their position; but from the beginning of the 13 th century the study of the effects of perspective on profiles clearly appears. We find a remarkable example in the cathedral of Amiens erected from 1225 to 1230. The internal belts, the bases and abacuses of the triforium are traced according to the point of view taken from the pavement of the church. (Art. Triforium).

See how the architect of the nave of Notre Dame of Amiens proceeded to trace the abacuses and bases of the little columns of the gallery (Fig. 27). The largest visual angle perpendicular to the nave is 60°, allowing one to see the abacuses. The profile was traced according to the method indicated at A, a method unnecessary to describe after the preceding demonstrations.

According to this visual angle, the abacus is reduced by t the perspectivi to the profile A'. By removing in the horizontal direction, i.e., by looking at the capitals of the bays beyond that found opposite to one, it is evident that one sees the profile develop, yet without ever taking the importance in height, with regard to the projections, that is given by the geometrical drawing. For the bases the profile is indicated

at B. Observing them at the angle of 60°, which served for t tracing them, one can see only the members indicated in B′; but taking a little greater distance, so as to see them at an angle of 45°, the profile given by the perspective is that at B″, which is satisfactory, and in harmony with the proportions of the little columns.

In general in Gothic edifices the inclination of the visual angle influences the trace of the profiles; it is then important when one measures and draws them, to mention their position. We cannot insist too strongly on the differences in drawing internal and external profiles in Gothic architecture. On the facade of the cathedral of Paris, the profiles develop in height in relation to their projection, according to the height at which they are placed; so that the abacuses of the capitals of the great open gallery are made of a course equal to that of the capital. Yet from the Place in front however, these abacuses do not appear to have more than a quarter of the height of the capital.

In the interiors, the horizontal profiles, to not lose their importance, and to not interrupt the vertical lines that dominate, have only a small projection. But on the exterior, as much to shelter the surfaces as to obtain great effects of shadow, it was necessary to give the profiles a pronounced p projection; men observed in this case that they are always r reduced on top by a wash, more or less inclined above 45°, which connects them to the upper wall plane, by thus avoiding always the bad effect of horizontal projections that mask a p portion of the elevation, and redule by as much the height of edifices. For example, it is clear that if one decorates a f facade by profiles like those indicated at A (Fig. 28), the visual rays being according to the lines a b, the vertical p parts c d are entirely lost to the eye, which cannot divine them; the monument seems to be lowered as much. But if the p profiles are traced according to the drawing B, the visual rays follow and see the wash, and these conceal no part of the surfaces, which retain their real elevation, consequently their relations and proportions.

This is elementary, and it seems that it would be useless to demonstrate it; yet one does not seem occupied in our modern architecture with these simple laws, and daily we see ar-

artists themselves greatly surprised that an elevation well proportioned in elevation, no longer produces in execution the expected effect.

In the course of this work, we have had many occasions to present drawings of profiles, and we do not believe it necessary to extend farther on the subject. What we wish to demonstrate here is, that chance or caprice had nothing to do with tracing the architectural profiles in the middle ages, that these are subject to la..s established by the necessities of construction, and on judicious understanding of effects.

PROPORTION. Proportion. Harmony.

The Greeks had a word to designate what we understand by proportion; "symmetria," of which we have made symmetry, that does not mean proportion at all; for an edifice may be symmetrical and not be arranged in proper or happy proportions. Nothing better indicates the confusion of ideas than false acceptation of words; thus we have also committed the fault of confusing in the art of architecture since the 16 th century, symmetry, or what is understood by symmetry, with the ratios of proportion; or rather they have frequently thought to satisfy the laws of proportion by contenting themselves with only the rules of symmetry.

The most ordinary artist can easily adopt a symmetrical fashion; it suffices for that to repeat at the left what is done at the right, while a very refined study is required to establish a system of proportions in an edifice, whatever it may be. One should understand by proportions the ratios between the w whole and the parts, logical and necessary ratios, such as s satisfy both the reason and the eyes. For a stronger reason s should one establish a distinction between proportions and dimensions. Dimensions simply indicate heights, widths and areas, while the proportions are the relative relations between those parts according to the law . "The idea of proportion," says M. Quatremere de Quincy in his Dictionnaire d'Architecture, "includes that of fixed and necessary ratios, constantly the same, reciprocal between the parts that have a determinate purpose." The celebrated academician does not seem to us to seize completely here the value od the word proportion. Proportions in architecture nowise imply fixed ratios, constantly

the same bottom parts having a determinate purpose, but on the contrary are variable ratios, in view of obtaining a harmonic scale. M. Quatremere de Quincy seems to us to express an erroneous idea concerning proportions when he adds:--

"Thus it is sensible that all the creations of nature have their dimensions, but not all have proportions so numerous and so evident, for example, that it would be impossible to determine with precision the reciprocal measure of the branch of a certain tree to the tree itself." The author of the Dictionnaire thus confuses dimensions with proportions; and if he had consulted a botanist, the latter would have demonstrated easily, that on the contrary there exists in all plants ratior of proportions established according to a constant law between the whole and the parts. M. Quatremere de Quincy again mistakes the true law of proportions in architecture, when he says:- "A true system of proportions is based not only on measures of general ratios, for example, as would be those of height of the body to its size, of the length of the hand to that of the arm, but on a reciprocal and unchangeable connection of the principal parts and of the subordinate parts and of the least parts with each other. Now this connection is such that each one taken by itself, is suited to teach by its measure alone, what is the measure, not only of each other part, but even of the whole, and that this entirety can reciprocally by its measure make known what is that of each part." If we properly understand this passage, it would result from the application of a system of proportions in architecture, that it would suffice to admit a sort of canon or module to ensure putting the monument in proportion, and that then the proportions would reduce to an invariable formula of ordinary application. "Here, again adds M. Quatremere de Quincy,"is what does not exist a and cannot be shown in the art of building of the Egyptians, nor in the Gothic; more useless still to seek it in any other architecture. And this is the incontestable prerogative of G Greek architecture." It must be admitted that this would be very unfortunate for Greek art if it were so, and that if this art were reduced in the matter of proportions to the rigorous application of a canon, the merit of the Grecian artists would be limited to very few things, the laws of proportion to a f formula.

Proportions in architecture are derived from more extended laws, more refined, and that are exercised on a field quite otherwise free. That the Greek architects may have adopted a system of proportions, a harmonic scale, is not and cannot be contested; but if the Greeks established a harmonic system that belonged to them, it does not follow that the Egyptians and the Gothic architects may not have adopted one on their own part. As much as to say that the Greeks, having possessed a musical harmonic system, one could find in the operas of Rossini and in the symphonies of Beethoven only disorder and confusion, because those authors proceeded quite differently from the Greeks. Whatever M. Quatremere de Quincy has said, proportions in architecture are not an unchangeable canon, but a harmonic scale, a correlation of variable ratios, according to the method adopted. The Greeks themselves did not proceed as assumed by the author of the Dictionnaire, and that is their praise, for there exists in their orders notable variations in proportions; with them the proportions are relative to the object or to the monument, and not to the orders employed. We have explained elsewhere [1] how certain laws derived from a geometry were accepted by the Egyptians, Greeks and Romans, Byzantine and Gothic architects, when it concerned the establishment of a system of proportions applicable to very different monuments; how these laws were not an obstacle to the introduction of new forms; how being superior to these forms, they could control their ratios so as to present a harmonious entirety at Thebes as well as at Athens, at Rome as well as at Amiens or Paris; how the proportions are derived, not from a blind method, from an unexplained formula, but from ratios between the solids and voids, heights and widths, surfaces a and elevations, ratios taken into account by geometry, whose study requires great attention, also variable according to the place and the object; finally, how that architecture is not the slave of a hieratic system of proportions, but on the contrary can change without ceasing, and find applications always novel, proportional ratios, as well as it finds applications varied infinitely, by the laws of geometry; and it is that in fact the proportions are the daughters of geometry, as well in architecture as in the order of inorganic and organic nature.

Note 1.p.534. See 9 th Entretien sur l'Architecture.

Proportions in architecture are first established on the l laws of stability, laws of stability derived from geometry. A triangle is an entirely satisfactory figure, perfect because it affords the most exact idea of stability. The Egyptians and the Greeks started from it, and later the architects of the middle ages did the same. By means of triangles they first established their rules of proportions, because thus these p proportions were subject o the laws of stability. This first principle being adopted, the effects of perspective were appreciated, and came to modify the ratios of general proportions; then were established the ratios of projections, of solids and voids, which are derived from triangles, at least during the middle ages. We have just indicated now in the least details of architecture lines inclined at 45°, 60° and 30° have been adopted as generatrices of drawings and profiles. The triangles adopted by the architects of the middle ages as generators of proportions are:- 1, the right-angled isoceles triangle; 2, t the triangle that we term the Egyptian isoscele triangle, i.e., whose base is divided into 4 parts and its altitude into 2.5 parts; [2] 3, the equilateral triangle. It is evident that every edifice inscribed in one of these three triangles will indicate from the first a perfect stability; that always when one can recall by points apparent to the eye the inclination of t the lines of these triangles, he subjects the drawing of an edifice to apparent conditions of stability. If portions of a circular circumscribe these triangles, the given curves will likewise have an appearance of stability. Thus the right-angled isosceles triangle A will give a semicircle; the isosceles triangle B and the equilateral triangle C will give broken arches, improperly termed pointed; curves that recall the general proportions of edifices generated by each of these triangles. These are general principles, as well understood, and w which extend to the application, as we shall see.

Note 2.p.534. See what we say concerning the use of these triangles in Art. Ogive, and in the 9 th Entretien sur l'architecture.

But it is first proper to indicated briefly the discoveries recently made by a learned engineer of bridges and roads, M. Aures, concerning the proportions adopted by the Greeks. M.

V. Aurez has demonstrated in several memoirs,[1] that to render an account of the system of proportions adopted by the Greeks, it was necessary to start from measures that they possessed, i.e., from the Greek foot and the Italian foot, and in what concerns the orders to seek ratios of measures, not at the foot of the column, but at its middle between base and capital; i.e., with the section taken at the middle of the height of the shaft. The shafts of the columns of the Greek orders being conical, it is clear that the ratios between the diameter of those columns, their height and intercolumniation, will sensibly differ if one measures the order at the base of the column or at the middle of the shaft. Then taking the measures at the middle of the shaft and using Greek feet in Greece or Italian feet in Magna Grecia (Italy), one finds ratios and measures, for example, such as 5 ft. for the columns and 10 ft. for intercolumniations, i.e., exact ratios a cording to the proportions indicated by Vitruvius. This is not the occasion here to insist on these ratios, it suffices for us to indicate them, so that it may be establshed that the architects of antiquity followed arethmetical formulas in the composition of their orders, numerical ratios, while the architects of the middle ages used triangles for obtaining harmonic ratios.

Note 1.p.536. See Theorie du module deduite du texte de Vitruve. Nimes. 1862. -- Etude des dimensions de la Maison carree de Nimes. 1864. -- Etude des dimensions de la colonne Trajan, 1863. -- Memoire opropos der scamilli impores de Vitruve. -- Memoire sur le Porthenon. -- Etude des dimensions du monument choregicque de Lysicrote.

There existed in France at Toulouse in a very flourishing province from the 11 th century a monument of great importance, but which was scarcely appreciated some years since, except by artists; it is the church of S. Saturnin, commonly called S. Sernin. That edifice being restored, or rather being relieved from the extravagances that denatured the general forms, suddenly in the eyes of the public assumed a considerable value. It is neither from the care devoted to the execution, by the richness of the sculpture or mouldings, nor by the details, t that this enormous structure has struck the eyes of the multitude, but only by the ratio of its proportions. The church

of S. Sernin was conceived by a learned architect, well versed in the knowledge of his art, possessing principles very developed in respect to proportions, but executed by rude workman by the aid of mediocre materials, denatured in the 16 th century by additions that destroyed the harmony, and therefore c classed in the number of those attempts of barbarous times.

Today let us say, due to the removal of some bays of the wall, to replacing the roofs in their old form, here is an e edifice, that massive as it is, presents an entirety of robust elegance, that charms the least experienced eyes, and furnishes a most interesting specimen of what an architect can obtain by a judicious balancing of the masses, and by a studied ratio of the parts, without the aid of any ornament. Grand instruction for us, who call to our aid all the resources of delicate execution, sculpture and superposed orders, complex profiles, yet do not always succeed in attracting the glance of the passer, and that spends millions to cause to be said sometimes:- "What do we want of those capitals, cornices and reliefs?"

The interior of S. Sernin, although much disfigured by a s sanctuary richly overloaded by ornaments in bad taste, and by a coarse roughcast of a displeasing color, has alone retained the fame that it merits. This interior in fact produces a striking effect, although on the whole the edifice is not of extraordinary dimensions. Yet excepting some capitals, the interior of the church of S. Sernin shows scarcely any mouldings; its piers of rectangular section are bare, like the surfaces of the arches af the vaults, one sees in all that only a structure, and the effect that it produces is due to the perfect harmony of proportions. How was that harmony found?

Let us first state a major fact; which is that in the architecture of the middle ages the harmonic system of proportions proceeds from the inside to the outside. The Greeks did not always proceed in the same manner, but the Romans did in their vaulted edifices and in the construction of their basilicas. This statement requires some illustrations. If we consider e externally the Parthenon, the Temple of Theseus, or even the temples of Magna Grecia, it is impossible to foresee the internal proportions adopted in those edifices. We see an external order conceived after an admirable harmony of proportions, but we cannot deduce therefrom the harmonic scale of the int-

interior. The external order of the wall of the cell conceals from us one or two superposed internal orders, arrangements of stories not visible on the exterior, open to the sky or w with a closed covering, stories that the outside cannot divine. So much that even today, one can inquire whether the interiors of these monuments were entirely closed or presented a sort of court. If the orders placed in the interior are established in a harmonic ratio of proportions with the external order, t there is a question purely conventional, but which cannot be appreciated by the eye, since those external and internal orders cannot be seen simultaneously. This is a theoretical satisfaction that the architect has given himself. Assume that the internal arrangement of the Parthenon is not known (and it is scarcely so), of ten architects that examine only the exterior, we shall not probably have two similar restorations of the interior. On the contrary, if ten architects examine only the exterior of the Roman baths, or the edifice known under the name of the basilica of Constantine at Rome, or again the church of S. Sophia of Constantinople, and they attempt to present the internal arrangement, it is evident that they will differ in that restoration only in some details of secondary importance. In edifices the external appearance is nothing but the exact envelope of the internal structure; consequently if we speak only of proportions, the harmonic system adopted for the interior, that has determined the proportions visible on the exterior. Thus it that the Romans have proceeded differently from the Greeks. But it is necessary to recognize, that the Romans were scarcely sensible of this order of simple beauty, expressed only by the harmony of proportions. They preferred richness and luxury or rarity of materials to an entirety, whose sole merit was to be harmonious; thus most of their edifices are not recommended by that exact use of p proportions, that strikes us, and that one never wearies of a admiring in the works of Greece. The Roman confuses dimensions with proportions, and for him grandeur does not consist in a harmony of forms, but in their extent. For him what is grand is so because it is vast.

Fortunately better endowed with the true feeling of art than the Romans, the western peoples of the Romanesque epoch gave to the study of proportions a singular attention. Either that

this feeling had been excited or renewed by the view of the Romano-Greek edifices of Syria, or that it was instinctive, we already see at the beginning of the 12 th century, that a harmonic system of proportions was adopted in the provinces on this side and beyond the Loire. But the harmonic system is established on the principle of Roman construction, i.e., it proceeds from the interior to the exterior, so that the skeleton visible externally is only the envelope of the internal conception. To be clearer, the architect proportions his monument internally, and this method furnishes the system of proportions of the exterior. This was a correct idea, it must be agreed; for what is an edifice, if not a necessity clothed? Is it not the content that gives form to the case? Does not foot impose the form of the shoe? And if we make shoes today in which could be placed the hand or the head just as well or as conveniently as the foot, is this to reason correctly?

The Greek edifices, however beautiful they may be (at least those remaining to us), resemble slightly those pieces of furniture, that were called cabinets in the epoch of the Renaissance furniture, sometimes charming, admirably decorated, precious objectsfor amateurs and museums, but which are in fact a pretext, rather than the expression of a real need. It was then not surprising tha the Greeks, passionate lovers of external form, should think of that form first of all, that they invented the orders in such happy proportions, left to place behind them services not always in intimate correlation with this harmonic system. The practical sense of the Romans each time that they ceased to imitate Greek monuments to remain truly Roman, had prescribed to them an entirely different mode of proceeding, as we have indicated above; but as we have also stated, there was lacking to them the delicate feeling for p proportions, and the Greeks were correct in regarding their g great concrete monuments, moulding the internal need, so to speak, just as we regard a beehive or the huts of beavers, finding there rather the brutal expression of a need than a work of art. Yet the Greeks were men with too much mind, not to seize all the advantage that could be derived from the Roman principle in applying to it new harmonic laws; this is what they did in Asia. They had the wisdom to abandon definitely the methods of proportions of the orders of antiquity, to

subject the Roman material structure to an entire system of proportions from the interior to the exterior.

That was a stroke of genius, or rather one of the resources that genius always knows how to find, when the conditions change within which it moves. It is then to reason outside the knowledge of facts and circumstances, to reason in vacancy, than to desire to relate all harmony of proportions to the Grecian orders alone. The Greeks adopted a harmonic system s suitable for the orders, when the orders formed all their architecture, so to speak; they adopted another when Roman architecture imposed itself on the world, and to discover new useful and necessary means. From the point of view of the structure, Roman architecture was an advance from Grecian architecture; the Greeks were very cautious not to attach themselves to traditions, that might still be dear to them, they frankly adopted the material progress accomplished, and subjected their feeling as artists to their philosophical minds. Thus they have transmitted methods, that were very quickly developed in the midst of our West after the crusades.

The church of S. Sernin of Toulouse is one of the monuments of our southern peoples, which gives the most complete and m most vivid impression of those Romano-Greek influences and p principles of proportion, that were applied to Roman construction by Greeks of the late empire. In fact the system of proportions adopted at S. Sernin proceeds from the interior to t the exterior.

This system of proportions is derived from equilateral triangles and right-angled isosceles triangles. We give first the half of the transverse section of the edifice (Fig. 2). The b base A B was divided into 20 parts of 2.755 ft. each. Five p parts were taken for half the width of the high nave; two p parts for the thickness of the pier, whose plan is given at C; four parts for the width of the second aisle, including the thickness of the engaged pier; two parts for the thickness of the wall at the base and one part for the projection of the battlements at the base.

The height of the internal bases being fixed at the level A, on this level they worked to establish the system of proportions, for one will observe that the level of the bases, which is regarded as the horizontal line serving as base of the tri-

triangles employed to establish the internal proportions of an edifice during the middle ages. Thus these bases are placed a about 3.23 ft. above the floor in the edifices of the Gothic period, and at 2.13 ft. at most in the monuments of the Romanesque period. The insides of the engaged piers were fixed at 16 1/2 parts apart. From this point was erected the equilateral triangle a b, that gives the total height of the edifice, the level of the imposts c, the level of the imposts d, and the height of the upper capitals e. From the same point a right-angled isosceles triangle a f being erected, it gives the level of the crowns of the arches g, the level of the capitals of the triforium f. From the point h (12 parts of the axis of the second pier is erected the equilateral triangle h i, which gives at its vertex the centre of the tunnel and cross vaults of the high nave. The other lines that we have drawn at 45° or 60° sufficiently indicate the secondary operations, without any need of describing them in detail. What results from this system is tha the architect has pretended to subject the proportions of his edifice to the trace of two triangles, rectangular isoceles and equilateral; for one will note that all the principal levels, the points that catch the eye, are placed on lines at 45° and 60°. The external outline of the edifice nowhere starts on any part of these inclined lines; it is as it were enveloped by those lines, and thus reproduces the internal forms and proportions.

If we examine (Fig. 3) two internal and external bays of S. Sernin, we likewise see that all prominent points of the architecture have been obtained by means of two of the same triangles, i.e., by the aid of lines at 45° and 60°, intersecting the verticals. In this manner results a geometrical relation between the parts and the whole; a sort of principle of crystallization, let us say, of great harmonic power. The proof is the effect that this edifice produces.[1] But the architect of S. Sernin, although employing a geometrical procedure for establishing the proportions of his edifice, has no less taken into account the effects of perspective.

Note 1.541. We have done this work after having not only m measured and drawn the church of S. Sernin, but after we could remove the heavy additions that modified its upper parts, and when we had thus even found the places of the old cornices and

the slopes of the roof. Only after having determined the position of each part in the most certain manner did we give ourselves to the work of research, that has unveiled to us the system of proportions adopted by the primitive architect. Being struck by the happy proportions shown to us by the work of removal, and the singularly harmonious effect of the whole, we sought its cause; for one is deceived, if he supposes that chance or feeling alone could produce such results, on an edifice so extensive and composed of so many parts.

Thus for example, if we glance at the external bays at A (Fig. 3), we see that the great equilateral triangle bays a b, which in the interior B gives the ratio of the height of the capitals to the spacing of the columns of the bays, by the effect of the perspective externally, the roof that disappears to the eye, the point d falls on the point e, and thus the equilateral triangle d f g completes the lines a e inclined at 60°. The crown of the archivolt f, when one places himself in the axis of the bay, is in a harmonious relation with the spacing of the buttresses of the two bays at the right and left, although on the exterior, because of the projection of the roof of the second side aisle, the architect may have to proceed otherwise than in the interior, where the bay presents itself in a vertical plane, and make a new operation above this roof; still one sees by this example, that he has been able to establish a relation between the two operations, that of the lower side aisle and that of the triforium. All that evidently denotes a very scientific art, a profound study of effects, of superior knowledge and consummate experience.

Elsewhere [1] we have explained how the proportions of the cathedrals of Paris and of Amiens were established by the aid of Egyptian and equilateral triangles. In fact, the right-angled isosceles triangle is rarely adopted as the principle of proportions in the edifices of the Gothic period; the triangle whose base contains 4 parts and the middle vertical rises 2.5 parts above the base (Egyptian triangle), and the equilateral triangle become henceforth the generators of the proportions.

Note 1.p.543. See the 9 th Entretien sur l'architecture.

Figs. 9 and 10.

We find a striking example of this in an edifice remarkable for the perfect harmony of its parts, the S. Chapelle of the

palace at Paris. This religious monument, from all time justly regarded as a masterpiece, proceeds with equilateral triangles in regard to its proportions.

The S. Chapelle of Paris consists of two stories; the low a and the high chapels.[2] See (Fig. 3) how Pierre of Montereau p proceeded to establish his plans and sections.

Note 2.p.543. Art. Chapelle, Figs 1, 2, 3.

At A is drawn one bay of the ground story; at B is one bay of the plan of the first story. In the second story the horizontal projection of the vaults is obtained by means of the equilateral triangle a b c, the apex c giving the centre of the bay of the vault; the ribs of the diagonal arches are projected in the lines b c, a c, the base a b being the internal span between walls. The level d of the internal plinth (see the transverse section) is the base of the operations. The face being the vertical e (the axis of the little columns of the arcade),the equilateral triangle e f g was erected on the base, of which e h is h f. The sides of these equilateral triangles were prolonged indefinitely. The horizontal line i k being g given as the level of the sills of the great windows, on the base i k equal to h e was erected the second equilateral triangle, of which l is the vertex. This vertex gave the height of the springings of the vault. The side g f prolonged gave a t m the crowns o the arches of the windows. For the lower chapel the axes of the isolated columns are found erected at the two ends of the base of the equilateral triangle, one side of which is n o. From the level p (impost of the low vaults) and of the axis of the columns, the intersection od the line p q with the prolongation of the side f e gave the crown of the windows of the lower chapel. The sides f m prolonged served to place the upper pinnacles. The slope r s of the roof is likewise drawn at an angle of 60°. Thus for the transverse section as for the plan of the first story, the equilateral triangles generated the proportions.

The same method of drawing was observed externally. If we take two bays of the S. Chapelle of Paris, we see (Fig. 5) that the axes of the buttresses being given at a, b, c, a c being taken as base, the equilateral triangle a c e was erected, w which gave the level of the sill course of the windows. The prolonged sides of this triangle laid on each bay gave a ser-

series of lozenges of all heights; those of the imposts and crowns of the window arches, that of the upper cornice g, that of the pinnacles h. As for the gables of the windows, drawn as triangles with sides below 60°, the equilateral triangle is s still recalled by the level of the astragal i of the upper cross flowers. In this edifice the unity of proportions is thus obtained by means of the use of equilateral triangles. Constant ratios are established between the parts and the whole, since the eye finds all the pronoipal parts placed at the vertices of similar triangles.

These methods allow rapid drawing, always established according to the same principle for each edifice. In fact the architects who attempt today to erect structures according to the so-called Gothic method, if they wish to follow their feeling (as habitually practised), to compose without the aid of a g geometrical method, soon find themselves stopped by innumerable difficulties. Not knowing on what bases to operate, they proceed by a series of trials, without ever finding either happy proportions or reassuring conditions of stability. It is certain, that if the masters of the middle ages had thus composed in uncertainty without fixed methods, not only would they never have been able to find time to construct such a great number of monuments, but also would not have obtained t that perfect unity of appearance, which charms and still surprises us today. On the contrary, starting from this principle of locating and proportioning by means of triangles, they could very rapidly establish the great general lines with the certainty, that the proportions are deduced thereby, and that the laws of stability are satisfied. Yet this is not to state, that the feeling of the artist should not intervene, for one could apply these methods according to combinations infinitely varied. The S. Chapelle of Paris and the cathedral of Amiens are evidently drawn by artists of uncommon worth; but besides these monuments, there are others where the principle of the use of triangles, although adopted, has been but imperfectly done, and consequently where the proportions obtained are vicious. We have a striking example in the drawing of the cathedral of Beauvais. This great monument, that presents such beautiful parts, a plan so broadly conceived, gives in section and consequently on the exterior, ungraceful proportions by forg-

forgetting one of the conditions of its drawing itself.

Contrary to the method adopted in the 13 th century, the entire system of the cathedral of Bourges i derived from the r right-angled isosceles triangle and not from equilateral triangles. This was a remnant of Romanesque traditions, still v very powerful in that province. The plan of the nave, some b bays of which we present (Fig. 6), is derived from a series of right-angled isosceles triangles. The principal nave gives s squares with two bays in pairs. As for the double side aisles, they were likewise produced by extending the sides of these triangles; but in the fear of exerting too active thrusts on the piers of the central nave, the architect has set the second row A of the piers within the axes a, so as to diminish the width of the side aisle. The centres of the crowns of the vaults of the first side aisle are thus transferred to b, and the centres of the vaults of the second side aisle to c. Taking the line e f as half the base, the architect (Fig. 7) erected the half of the great right-angled isosceles triangle e f g, whose sides by their intersection with the piers gave the levels h of the band of the triforium of the great side aisle and of the abacuses of the capitals i of the side aisle. Drawing a horizontal line from the apex g, the intersection of this line with the vertical axis of the piers of the second side aisle at k gave the base of a second right-angled isosceles triangle, whose half is g k l. The point l fixed the crown of the transverse arch and consequently the height of the nave. To be logical, the point l should have given the level of the base of a third right-angled isosceles triangle o p q, whose vertex q would have been the crown of the transverse arch of the high nave. Thus the distances between the extreme axes w would have given the base of the first triangle, the distance between the intermediate axes the base of the second, and the distance between the internal axes the base of the third. Thus would be obtained a perfectly harmonious proportion; while the vertex of the second triangle having given the crown of the transverse arch, there results from this a crushing of the u upper part of the edifice, which destroys all harmony. The h high windows appear too short by half, and the great side aisle is much too high in proportion to the height of the great nave. We are much disposed to think that this method was only

adopted as a means of rapidly terminating the edifice, the r resources then beginning to fail, and that the primitive project gave the proportions indicated in our Fig., which are t the natural deduction from the system employed. A fact strengthens our opinion; the upper flying buttresses drawn at m (the existing flying buttresses, and that are the only ones dating from the primitive construction of the nave) appear to have been rather arranged to abut the vaults C than the vaults D. However that may be, that there was a change or reduction of the primitive project, the interior of the cathedral of Beauvais is in bad proportions, and that is because the method adopted has not been followed rigorously in its consequences. One cannot say as much of the interior of the choir of Beauvais, which was a masterpiece before the changes that the 14 th century made in the primitive arrangements. All parts in this vast edifice are based on an equilateral triangle from the p plan of the entirety,and the details of the sections and elevations. Unfortunately the cathedral of Beauvais was erected with too moderate resources and weak materials, both in quality and height; disorders caused by the bad execution required works of renewal and strengthening, the doubling of piers, w which in great part destroy the truly prodigious effect produced by this immense interior, so well conceived theoretically, and drawn by a man of genius. In spite of its beautiful proportions, the church of Notre Dame of Amiens is inferior to what remains of the cathedral of Beauvais, and that of Cologne built some years later on a similar plan and sections, is very far from presenting such happy arrangements. There at Cologne the architect has rigorously followed the geometrical principles; his composition is a formula that takes into account neither perspective effects nor the deformations apparently suffered by the curves, because of the height at which they are placed. Thus the choir of Cologne surprises more than it charms; the geometer has suppressed the artist. It is no the same at Beauvais, nor in any one of the good edifices of the French Gothic period. the artist is always present beside the geometer, and at need he knows how to soften the formulas. V. Boisseree, in his monograph on the cathedral of Cologne, has perfectly emphasized the use of the equilateral triangle in the construction of that edifice. But the learned archaeologist

does not seem to us to have thoroughly studied our monuments of the preceding period. M. Felix de Verneilh has noted some errors of M. Boisseree concerning our cathedrals, notably in what relates to the dimensions of Notre Dame of Amiens;[1] but on the other hand, M. Felix de Verneilh has not attached to t these geometrical methods the importance that they merit. "To draw a plan according to the principle of the equilateral triangle is a forced idea like any other; but was it in the thought of the master of the work? It is a restraint rather than a source of harmony; was the master of the work embarrassed by it? Our great artists of the 12 th and 13 th centuries, as attested by their monuments, were directed by experience and not by theories in the creation of the pointed style. Men of good sense before all, they had only one rule or principle; to attain the greatest effect with the least possible cost, avoiding the faults and appropriating the succe ses of their predecessors. The architect of Cologne, who followed them directly and imitated them so closely, would he already become so strong in mystic architecture? For our account, we have much difficulty in representing it to ourselves, and we should voluntarily think that this science, affected and useless, c came to the world too late, for example in the 15 th century with freemasonry, when the architects no longer had only to refine and subtilize everything." We have cited this passage from a pen of authority, because it tends to establish a certain confusion in the study of the art of the middle ages, a and that it supports an injurious prejudice, in our opinion. Geometry and its applications are not a science useless to architects, and it is not a forced idea to use a geometrical figure to establish harmonious figures in architecture. We shall even say that it is impossible to conceive and develop a harmonious system without having recourse to geometric figures or to arithmetic. The Egyptians and Greeks did not proceed otherwise, and good sense can indicate no other methods of procedure. It is not doubtful that the architect of Cologne and his successors in France and Germany refined on the systems of their predecessors, but we have just demonstrated that they possessed them, and it was not possible to erect such m monuments without possessing them. A geometrical or arithmetical system suitable to establish laws of proportions, far from

being a restraint, on the contrary is an indispensable auxiliary, for it may well serve us as a rule, compasses and triangle in expressing our ideas. We cannot establish an edifice by the aid of a vague and indefinite empiricism. Let us also say, that in the productions of the human mind, rules have never been a restraint, except for ignorant mediocrities; they are an efficient aid and a stimulant for the minds of the elect. The very severe rules of musical harmony have not prevented the great composers from producing masterpieces, and h have not stifled their inspirations. It is the same for architecture. The merit of the architects of the middle ages is to have possessed such definite rules, to submit to them and use them. A misfortune in the arts today, and particularly in architecture, is to believe that this art can be practised under inspiration of pure fancy, and that one erects a monument with that very vague principle that it is desired to call taste, just as one composes a woman's dress. Our masters of the middle ages were more serious, and when they laid the rule and triangle on their drawing boards, they knew how they were to proceed; they progressed systematically, geometrically, without passing their time in sketching at hazard, while awaiting this vague inspiration, that idle minds are accustomed to make a religion.

Note 1.p.549. See Cathedrale de Cologne, by Mo Felix de Verneilh. (Annales Archaeol. 1848).

Besides the use of these geometrical methods was not an invariable formula, we repeat, it was a means suitable for obtaining the most varied combinations, but those were derived from a principle, that could not be mistaken without falling into falsity. Let us then see now the architect of the choir of Beauvais undertook to establish his plan and elevations.

Fig. 3 gives a portion of the choir of the cathedral of Beauvais, the axis being at A. First the axes of the principal piers supporting the high nave were fixed at 46 ft. apart. At a point a taken on one of these axes was drawn a line at 60°, which gave the point b by its intersection with the other axis, the centre of a pier like the poin a. Drawing from the point b a perpendicular to the axes, there is obtained the intersection c, the centre of a third pier. Thus were fixed the centres of the piers. By always proceeding the same and prolonging

the lines at 60° was obtained a series of equilateral triangles, that gave at their vertices the axes C of the intermediate piers of the double side aisle and the external face D of the wall of the side aisle. The diameter of the cylindrical nucleus of the piers of the high nave has been fixed at 4 ft., and that of the intermediate piers at 3 ft. 4 ins.; the thickness of the wall D at 4 ft. Thus were established the axes, t the spacing of the piers and the widths of the side aisles. Geometry alone has so far intervened. By his method, he is c confident of having established harmonious relations on the horizontal plane. In fact one condition of harmony in the m matter of architecture is to avoid the direct appearance of equal divisions, yet to cause these ratios to be established. By means of this drawing the spacings of three piers of the choir are equal, but those distances are more than half the span of the nave. The axes of the piers a and e are spaced ap apart more than half the direct distance c b between the axes, while the axes of these piers a and c are spaced apart half the diagonal a b. There is then a relation and a dissimilarity. Likewise the axes of the piers a and d are less far apart than the axes a and c, but between them is a distance equal to half that between the axes a and e. The spacing d f is less than the distance a d. So that if lengthwise the bays are similar, they are dissimilar in a transverse direction, diminishing toward the sides. That also conformed to the rules of stability, for it was important to reduce successively the thrusts in approaching the outside.

But this choir opens on a transverse aisle equal in width to the great nave. The architect, artist and practician feel that the great archivolts turned from the piers a and c will exert an active thrust on the first pier g of the choir, that is no longer shored at the height of those archivolts. He first increases the section of that pier; and then diminishes the span of the first bay B.

Not only does he thus submit his drawing to a law of stability, bu he satisfies the eye by giving more strength to the angle pier and le s span to that first bay. He reassures the eye, just as the Greeks did, when they reduced the last intercolumniation at the angle of a portico, and increased the diameter of the corner column. At G on the bay of the transver-

transverse aisle, this architect intends to erect a tower; he reinforces the piers h and i as we have drawn. This method applied in the horizontal plane gives the means of tracing the arches of the vaults according to harmonious relations. Thus for the transverse arches, the architect divided the base in 4 parts and has taken 3 of these parts for the height of the rise i j; for the diagonal arch, he also divided the base m f in 4 parts, and took 2.5 parts for the rise n o; it results from this that the rise n o equals the rise i j within a few inches. Two of the last parts served as base f n of the side arches, whose centres are f n, and thus enclose an equilateral triangle; for one will observe that the base n f equals the side f p, the horizontal projection of a side arch. On its horizontal plane the architect established thus all the harmonic relations of the parts, the arches of the vaults, and only had to proceed by an analogous method in vertical projection, for the ratios of rises and spans to be established. Taking o one bay c a in elevation (Fig. 9), and drawing from the axes of the piers equilateral triangles forming a series of lozenges, the vertices a gave the level of the imposts of the archivolts of the side aisles; the vertices h of the triangles with base taken at the height of the astragals c of the little attached columns gave the level of the lower band of the triforium; the intersection of the vertical lines d with the sides of the triangles, the level e of the upper band of the triforium; the vertices f are the level of the imposts of the great vaults, and the points of intersection g, the level of the imposts of the side arches. It results from this drawing that the height n p (the operations are always made above the bases) equals the width of the great nave between the axes of the piers. (See the plan); that the height b k of the triforium equals the height o b, that the height b f equals the height h p, or the width of the nave between axes; yet by the shifting of the triangles at c, there is a difference b o which prevents the eye from divining these exact ratios, that would be offensive; every harmony of proportions requiring, as we stated above, ratios but not similarities. One also verifies that the line m n equals the base of the triangle; i.e., to the distance between the axes of the piers of two bays,

which gives the appearance of stability to the pier, so to s speak, stayed by those imaginary sides, that the eye traces w without taking them into account; that the archivolts at s are tangent to the prolongation of these sides; that likewise the capitals i that support the great vaults are shored by the s sides j, i. If we could follow that composition into all its details, we should see that this principle is applied in the drawing of the triforium, the tracery of the windows, etc.

If we now take an edifice having only one vaulted aisle, like the hall of the synod of Sens, built at the same time as the choir of Beauvais, we shall see that the architect proceeded after a method similar,to that just described. A quarter of one bay of that hall being represented by A B C (Fig. 10), the vault is first traced; i.e., on the horizontal projection A C of the diagonal arch was drawn the semicircle a b, which is the revolved half of that arch, taking on the half diameter a C a distance a d equal to half the base of the transverse arch, and erecting a perpendicular d e to the line a C, t the point of intersection 1 gives the crown of the transverse arch, and a e is its curve; then d e is the rise of this transverse arch. From the level of the base f g, of the piers, erecting an equilateral triangle f g h, and on the vertical dropped from the vertex taking a length h d equal to e d, the o point d gave the level of the imposts of the arches of the vaults, and the proportions of the hall were thus established. For a drawing of the windows that close the end of the hall, he proceeded by means of equilateral triangles, as indicated by the side i K. These ratios of proportions have been established between these windows of the hall itself. [1] Beneath the great hall of the synod of Sens exists a ground story vaulted on a row of columns. The procedure employed for establishing the proportions of that interior is the same as that just indicated, and our Fig. 11 will relieve us from a new explanation.

Note 1.p.555. Art. Solle.

These examples suffice to demonstrate that a harmonic system of proportions was adopted by the architects of the middle a ages in the composition of their edifices, a system that proceeded from the interior to the exterior. This system essentially differs from that of the Greeks, which proceeded from the exterior to the interior and by numerical ratios; but one

cannot deny that it is logical and according to the laws of statics. It is then not to compare these systems and to desire to apply the methods of one to the other; one can only study them separately. Because the Greeks invented the orders and kave them excellent proportions, one cannot conclude from this fact that there cannot exist another principle of proportions; and if the column in the architecture of the middle ages is not subject to the laws of proportion, that control the Greek column, so that it longer has only relative proportions instead of possessing absolute proportions, one cannot conclude from this that Gothic architecture is without any principle of proportion, as M. Quatremere de Quincy has done. In Romanesque and Gothic architecture, the column is no longer a support d destined to sustain a lintel; it is a member receiving the arches of the vaults; its function no longer being the same. Instead of being a principal object in architecture, it is only an accessory object, that is subject to the general laws of construction and to the proportions on which that is established. But on this point, as on many others, when it is necessary to compare the arts of antiquity and those of the middle ages, men begin with a mistake; just as well say that the French language is not a language, because it has a syntax different from Greek syntax, or that a horse is a deformed animal because his organization essentially differs from that of a swallow. In our opinion, this is to reduce the field of studies, and to singularly lessen the resources of the art that pretends to restrict the human mind to a single comparison between Grecian art and the art of the middle ages, it is first necessary to impose on a Greek architect the programme, that was given to the architect of the cathedral of Beauvais, and to see how by the aid of those elements he could satisfy it. Now the programmes given in our days sensibly approach to those imposed on the architects of the middle ages; more than those given to the Greek architects, and one can scarcely conceive how to satisfy them, either by material means or by the forms of art, that one should rather resort to Greek architecture than to that adopted by the artists of the middle ages; and for what reason should be suppressed that order of human works, which supply elements applicable in all points of view?

But in another part of this work, [1] we have emphasized the no

less great dissimilarities between antique architecture and that of the middle ages; we have shown that if the architects of Greece and Rome subjected the parts of their edifices to the module, i.e., to a system of proportions dependent on art alone, the architects of the middle ages took into account t the human scale, i.e., the dimensions of man. That is a capital point and must necessarily establish a new element in the system of froportions. In fact, bases, capitals, diameters of columns, mouldings and bands, window sills, according to the rules of the artists of the middle ages must quite at first recall the human height, whatever the dimensions of the edifice. This was a means of presenting to the eye the true dimensions of the monument, since thus was established in all parts an exact ratio to man. [2] We admire as much a any person the principles of proportion that governed Greek architecture, but we do not think that those principles are the only ones admissible; we are indeed compelled to recognize the existence of a new mode of procedure by the masters of the middle ages, and in studying it cannot mistake its importance. The Greeks admitted the power of numbers; this was a religious principle among them, so to speak. Odd numbers and their multiples dominate, 3, 7, 9, 21, 49; but they did not take into account the human scale. they established a perfect harmony by the aid of these combinations of numbers. That is certainly admissible and merits even more attentive study on the part of those, that pretend to possess a monopoly of the knowledge of this art (although they are satisfied to continually study the products, without ever deducing from them a philosophical system, let us say); but besides or as a result of that very interesting arithmetical method, there is the geometrical method of the middle ages, and the intervention of the human scale, which have a certain value and cannot be disdained.

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We have so far presented in this Article only examples taken from religious monuments; yet it is unnecessary to conclude t that the architects of the middle ages did not think of proportions, when they erected civil edifices. Far from that; we see them follow their principles of proportion by the geometrical method in monuments of public utility; in houses and even in defensive works; for they did not think that a tower would be defended worse against assailants because established in happy proportions. And in that we do not hesitate to give an artist's brevet to those masters too much scorned. Certainly it was easier to proportion a monument by combinations of numbers, independently of the human scale, than to satisfy the eyes by observing the law of the human scale. Then combinations of numbers could no longer be applied, for it was always necessary to start from an invariable unit, the height of man, and yet to find harmonious ratios; one comprehends how in this last case, the geomtrical method should be preferred to t the numerical method.

Let us again take an example, this time from a civil edifice. The facade of the old hospital of Compeigne dates from t the middle of the 13 th century; it is a simple gable closing the hall of two bays. To put this facade in proportion (Fig. 12), the architect has used the Egyptian triangle, i.e., the triangle with base of 4 parts and perpendicular to the base has 2.5 parts. Not only is the inclination of the apex of the gable given by the sides of the triangle, but our Fig. shows that the lines parallel to these sides give the levels of the capitals a, bases b, capitals d, and the slope c; these sides are repeated at f above the upper windows and outline gables with no other reason than to recall the generating triangle; that the window arches g are inscribed within the sides of the triangles; that the eye sees the points h, i, m, n, all placed on these sides. The method being adopted, for example, the architect established a geometrical relation between the long windows of the ground story and the doorways, as indicated by the sketch A. Then the eye finds on that entire facade points placed on the inclined lines parallel to the sides of the generating triangle. There result naturally from the ratios a series of harmonic deductions, which constitute an actual system of proportions. Let us add that on this facade, as

in all architecture of the middle ages, the human scale is t the starting point. The buttresses are 3 ft. wide; the plinth is profiled at 4 ft. above the ground; the doorways are a fathom in width, etc.

If one takes the trouble to apply this method of using triangles as a means of placing edifices in proportion, in all monuments of the middle ages having some value, one will always find that they proceeded by logical drawings, establishing harmonious proportions by parts and lines parallel to the sides of these triangles, and marking to the eye points that recall these lines inclined at 45°, 60° or at 52°.

If instead of following without examination or analysis traditions, whose principles we no longer seek to discover, we s should assume confidence in the use of reasoned methods, we could derive a system from these examples of the architecture of the middle ages and employ them, not to flatly imitate them, but to extend or perfect them. We should perhaps arrive at establishing a harmonic system of complete proportions, when we possess none, and leave ourselves to chance, or to what we call feeling, which is all one. No one will dispute that the Greeks were endowed with a delicacy superior to our own. On every art question, if those men, being placed in an excellent atmosphere, believed it necessary to resort to arithmetical laws when they desired to put an edifice in proportion, and did not trust themselves to that capricious and variable inspiration, that we decorate by the name of feeling, how shall we, equipped only with ruder senseu, have the pretention to recognize no law and proceed by chance, or to believe that we follow the laws established by the Greeks, when we can no longer interpret their sense, limiting ourselves only to producing their letter? Measuring the Parthenon a hundred times with differences of a f few 16 ths of an inch, of what use will be this compilation of documents, if we do not know how to deduce the generating principle of the proportions? Just as much use in copying a hundred times a text whose meaning remains unknown, limiting one's s self to imitating with more or less material accuracy the forms of the characters, the accenting and the interlineations. Left to themselves and far from the examples left by antiquity, the artists of the middle ages have gone farther than we in seeking and finding a logical principle of proportions, and in k

knowing how to apply them. Then it is not an advance to ignore those principles; it might be one to know them and to find o others more perfect. But we can never accept as an advance the ignorance of an earlier fact. On the contrary, progress only results from the knowledge of preceding facts with a more just appreciation of their value and a better application. That g good sense revolts at the idea of employing today in architecture forms adopted by the civilizations of antiquity or of t the middle ages is natural; but what sensible mind would dare to pretend it necessary to ignore, to leave in oblivion the results obtained before us to produce a work superior to those results?

If the harmonic system of proportions adopted by the Greeks differs from that accepted by western architects of the middle ages, the bond connects them. Among the Greeks, the harmonic system is derived from arithmetic; from geometry among the western men of the middle ages; but arithmetic and geometry are sisters. In these two systems is found the same element; ratios of numbers, ratios of angles and dimensions given by similar triangles. But to copy Grecian monuments, without knowing the numerical ratios by which they were put in proportion, and the logical reason for those ratios, and set at naught the geometrical method invented by the men of the middle ages, cannot be the means of obtaining this progress of which we say much, without your seeing it developed.

It would be more sincere to recognize that in the matter of the principles of architecture today, we have all to learn from our predecessors, from the art of construction to those grand harmonic methods of antiquity or of the middle ages. For wise conceptions, profoundly reasoned, men have substituted a sort of rude empiricism, that consists either in imitating earlier forms without understanding them, or in combining them without order or reason, thus producing actual monsters, which inspire one with disgust and weariness, when the first astonishment is passed. When these chimeras are offered to us as progress, the future will do justice to them, and will see only confusion and ignorance in these degenerate products, only piled up by the aid of powerful means and enormous expense.

We firmly believe in progress, we verify it joyfully within our modern society; we are not of those skeptics, who admit

that in this world good and bad are always distributed in equal parts. But it is in this time, even in our advanced civilization, where reason meets repulses; now in what concerns our art, we are in one of those periods. Is it to be believed that all is lost? Certainly not; our art will recover by the aid of these historical studies, very badly seen by some, but which are preserved in spite of all, will be continued, and will p produce fruitful results. Let us learn to know better the arts of ancient times; patiently analyzing them, we shall have established the foundations of the arts in our age; we shall recognize that besides material facts, which constantly differ, there are invariable principles, and that if history arouses curiosity, it also unveils, for those that know how to probe it, treasures of knowledge and experience, that the intelligent man must employ.

PUIE. Balcony.

An old word equivalent to the modern word balcony. (Old French poem).[1]

Note 1.p.561. Gilles de Chin, romonce of Goutier of Tournoy, 14 th century. Verse 477 et seq.

It is very rare to find balconies in Paris on houses of the middle ages arranged like ours. Projections on facades allowing one to jump down into the public street or the area of a court are generally covered; these are then galleries or loggias. (Arts. Breteche; Loge).

PUITS. Well.

A cylindrical hole sunk into the ground to reach a layer of water. Wells are either cut in the rock or are lined internally with masonry to keep out the earth. They are crowned at the level of the soil by a curb of cut stone, serving as a parapet, and terminated at their lower part by a wooden wheel that served for their construction, and which remains permanently below the level of the layer of water.

The constructors of the middle ages proceeded just as we do to dig a well. Excavating a cylindrical hole, they placed in it a wheel of oak, on which was built a wall like a round tower. Gradually excavating under this wheel, that sunk with the masonry that it supported; as the wheel sunk, they extended this

cylindrical masonry in the upper part.

There still exist a great number of wells of the middle ages in our old cities, in castles, cloisters, palaces and houses. They are lined with cut stone; their diameters are quite variable. There are wells with only 3 ft. diameter inside, and others with even 12 or 18 ft.

Nearly all churches possess a well, either sunk in a crypt or a side aisle. These wells were originally dug for the needs of the constructors; the edifice being completed, a curb was placed at the opening, and they were reserved for the service of the worship. Most cloisters of monasteries were provided w with a well, when the location did not permit of fountains at the level of the ground. The curbs of those wells are cut with care, often in a single block of stone, and decorated by sculptures. The water was drawn by means of a bucket suspended by a rope running over a pulley; the suspension of the pulley be became an ornamental motive, sometimes very happily conceived. The bucket for raising the water was fastened to the rope, and to pour the water into a pail that could be carried, there was frequently cut on the curb a sort of channel with a gargoyle. One still sees those curbs in our cloisters or old palaces. [1] Fig 1 presents one of them belonging to the 13 th century.

Note 1.p.563. There exists a very beautiful one at Sens in the storerooms of the palace of the archbishop.

On the squares of cities were dug large wells, if the location did not permit the establishment of a fountain. One of the most remarkable works of this kind is the principal well of the city of Carcassonne. This well is bored through an enormous bed of sandstone, and most probably dates from very high antiquity. Its internal diameter is 8.4 ft. The actual depth is 99.2 ft. The water layer sometimes rises to 20.7 ft. deep, but it is often dry and is partly filled up. An old tradition claims that before abandoning Carcassonne, the Visigoths cast into this well a part of their treasures; but excavations made at different times, and particularly recently, h have raised from the cavity only a bucket and some rubbish without value. This well is now crowned by a sandstone curb, w whose arrangement is curious. The sandstone base is 3.3 ft. h high and 8.7 ins. thick, supports 3 marble piers joined at t

their tops by 3 beams (Fig. 2). From each beam was suspended a pulley. Thus three persons could draw water at the same time. At A is drawn the plan of the well; at B is its elevation.[2]

Note 2.p.563. Histoire des comtes de Carcassonne by Besse. (Carcassonne. 1645). See the verses in dialect on the marvels of this celebrated well. According to the poet, the depth of this well attained no less than the centre of the earth.

In a small square in the same city exists another well likewise cut in the rock, but of smaller diameter, whose curb and the suspension of the pulley merit mention. We give the plan at A (Fig. 3), and at B the elevation of this monument, which like the preceding one dates from the 14 th century. Here the cross beam connecting the two piers is of a single piece of sandstone. We have sketched at C the detail of the bases of the piers in the same pieces with the pilasters penetrating the curb, so as to prevent the overthrow of the two monoliths. The depth of this well is 70.5 ft. and the water depth is 11.5 ft.

Men did not always have at command materials resistant enough to allow the use of piers and crossbeams of stone of such small sizes; then the part required for attaching the pulleys was made of iron and fixed on a curb of cut stone. There yet exist in some cities of France wells that have retained their iron fixtures of the 15 th and 16 th centuries. (Art. Serrurerie).

If wells placed outside on the public roads were very simple, those opening in churches or cloisters were often very richly ornamented. Their curbs and the supports of the pulleys became motives for decoration. There formerly existed in the side aisle of the cathedral of Strasburg a very rich well cut in sandstone. Its curb was hexagonal in plan. On three sides rose three piers supporting three lintels uniting at the centre of the hexagon (see plan A, Fig. 4), supporting at their junction the pulley attached to a pendant. The three lintels were decorated by arches with rosettes and cusps. A cornice crowned these lintels. (See elevation B).

The curb rested on a step C surrounded by a projecting gutter D, to prevent water dripping from the bucket from flowing over the pavement of the church.[1] This well dated from the 14 th century, and was only removed during the last (18 th) century.

Note 1.p.567. We possess a drawing of this well, that is further represented in an old engraving representing the interior of the cathedral of Strasburg.

Many crypts possessed wells, the water of which often passed for miraculous. A very old one is still seen in the crypt of the church of Pierrefonds (priory), whose water is said to h heal intermittent fevers.

It is scarcely necessary to state that the keeps of castles were equipped with wells dug and lined with the greatest care. The keep of Coucy has its well, very large and deep (Art. Donjon).

A great wheel with windlass served to raise the bucket. In one of the towers of gate Narbonne at Carcassonne (that on the right in entering the city), there exists a very large well in the middle of the lower hall, but not deep, the water being but a few yards below the top of the ground. The curb of this well rises little from the pavement, and is only a circular capital with spout. Several persons may thus draw water and very rapidly fill a cask or great vessel. Many other towers of the c city of Carcassonne possess wells. That of S. Nazaire has one with two openings, one at the level of the exterior, the other at the level of the second story. (Art. Tour). In the buildings of the 13 th century of the abbey of Chateau-Landon is still seen a well 3.4 ft. diameter, arranged so as to serve several stories, as indicated by section C. (Fig. 5). This well with plan sketched at A is included in a buttress projecting on the exterior of the building. The raising of the bucket is only done at the story B (see section C) by means of a wheel and windlass. There are still seen at a and a′ square holes made in the stone, or rather made in the height of a course, that served to pass the rotating axis of the windlass into the middle of a wooden block, well squared and 9.8 ins. square. The rope of the well took one or two turns around the drum of the windlass (see plan A and section D), the buckets were suspend d from two oblique pulleys e fixed at g in the upper part; so that by turning the wheel in either direction, the buckets were raised to the level of one of the two stories, where they were stopped by a man charged to receive the contents. This very simple mechanism is indicated by the plan A′ and by the section D. [2]

Note 2.p.567. We owe the drawing of this well to M. Boudot.

In the courts of houses of the middle ages in Paris are still found wells of quite elegant form.

The little service court of mansion de la Tremoille at Paris

possessed one with a curb or beautiful curvature. These wells were often set against kitchens or stables, and the pully was then suspended from a projecting corbel built in the masonry above the curb. These corbels represented animals holding between their paws the pulley, or indeed half arches with cusps, rosettes, etc. The well of the palace of the dukes of Burgundy at Dijon still has the support of the pulley, representing a lion issuing from the wall. Wells are often charged with shields of arms, emblems, devices and inscriptions.

Here (Fig. 6) is a pretty well, still entire, in the court of a house of the little city of Montreal. The curb is externally octagonal and circular inside. Two pieces fixed on two sides of the octagon (see plan) support a stone lintel from which the pulley is suspended. On one pier is seen a shield with orle and charged with a squirrel (see detail A), and below is a little cartouche on which is engraved the following inscription; "John of Brie made me in the year 1526." Were it not for this inscription, a much earlier date could be assigned to t this well, for it has all the characteristics of the beginning of the 15 th century. (See profiles B).

The Renaissance excavated wells, whose curbs are frequently sculptured with much art and refinement; very beautiful ones are seen at Troyes, Orleans, Sens, Tours, etc.

In Article Serrurerrie we shall have occasion to mention beautiful wrought iron equipment for wells.